

# AUTOMOBILE ENGINEER

DESIGN • PRODUCTION • MATERIALS

Vol. 48 No. 11

NOVEMBER 1958

PRICE: 3s. 6d.



Atlas Copco 'Twin-Air' rotary screw compressor in 100 cfm capacity installed at the Grängesberg mine, Sweden.

Tested for two years in Arctic Circle iron

THE NEW 'TWIN-AIR'

## Rotary Screw Compressor

At Kiruna, in the Arctic Circle area of Northern Sweden, where the world's largest underground mine is being developed, Atlas Copco rotary screw compressors have been running under full operating conditions for two years.

SIMPLER DESIGN • EASY TO INSPECT • HIGHER EFFICIENCY  
LOWER INSTALLATION COSTS • LESS SENSITIVE TO INSURE AIR  
OIL-FREE AIR OR GAS • SMOOTH AIR FLOW  
MODELS UP TO 16,000 C.F.M.



A pair of rotors with inlet and outlet ports indicated by the dashed lines.

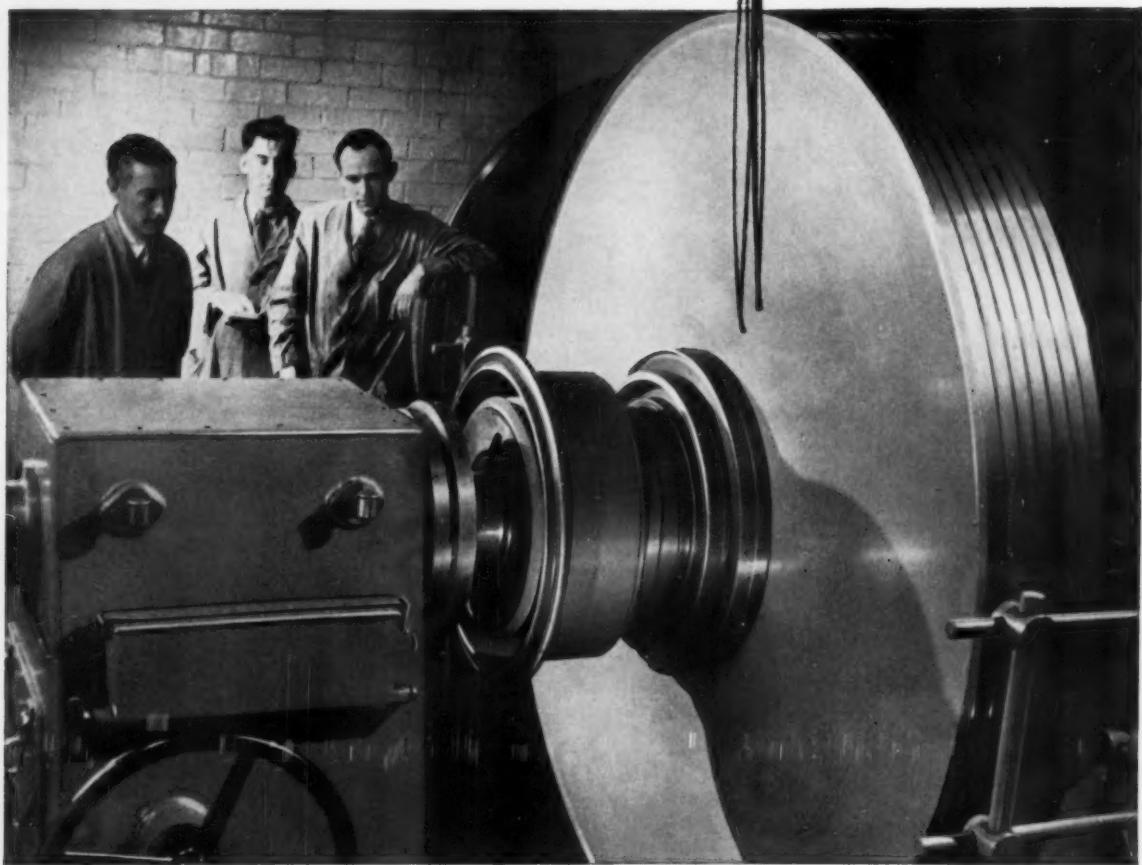
### A COMPLETE RANGE OF COMPRESSED AIR EQUIPMENT

Atlas Copco manufactures portable and stationary compressors, rock-drilling equipment, loaders, geomatic tools and paint-spraying equipment. Sold and serviced by Distributors or Agents in many countries throughout the world.

**Atlas Copco PUTS COMPRESSED AIR TO WORK FOR THE WORLD**

Contact your local company or agent or write to: Atlas Copco (Gt. Britain) Ltd., Brookfield Road, Wembley, Middlesex, or Atlas Copco AB, Stockholm 4, Sweden.

# FULL STOP to twenty five double decker buses!



This Mk V Inertia Machine tests Mintex Brake liners under controlled conditions, for friction, fade and general performance. It subjects them to stresses greater than any met on actual service. The flywheels are brought up to a given speed, the brake is applied, and torque, brake drum surface temperature and stopping rate are recorded. The Mk V, one of the largest machines of its kind in the country, generates up to 18½ million ft/lb kinetic energy—equivalent to the energy absorbed in halting 25 double decker buses from a speed of 30 m.p.h. Together with many others similar machines in the B.B.A. laboratories it provides one of the reasons for the

long and consistent service that Mintex brake liners give. Research has always been the heart of our business. It continues today with greater emphasis than ever, making sure—and doubly sure—that

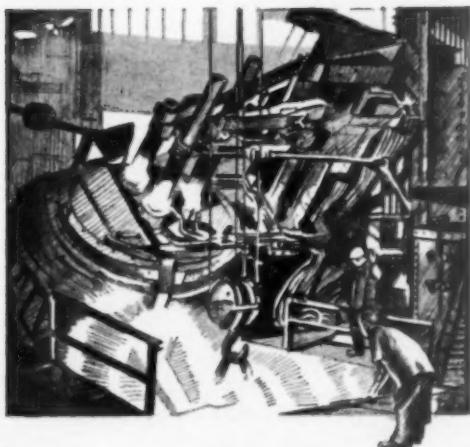
*you can rely on*  
**MINTEX**

**Mintex Brake and Clutch Liners** are manufactured by British Belting & Asbestos Limited, Cleckheaton, Yorkshire, and are available from MINTEX Service Depots and Distributors throughout the country.

*no  
place  
for*

*chance*

*in the manufacture of*



**OSBORN**



**OSBORN  
FINE  
STEELS**

Tool steels, stainless steels, heat-resisting steels, manganese steels and a wide range of alloy steels are produced by Samuel Osborn & Co., Limited. The reputation of these steels, including the well-known brands of *Hand & Heart*, *Titanic*, *Musket*, *Tropic* and *Titan*, depends upon their quality and their quality depends upon rigid control in manufacture.

The results of the experience of generations of steelmakers are blended with the latest technical advances in melting practice, to produce steels which will meet the most exacting standards—there's no place for guesswork in the art and science of steel-making.

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ENGINEERS' TOOLMAKERS**

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CLYDE STEEL WORKS • SHEFFIELD • ENGLAND



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Since E.N.V. pioneered spiral bevel, and later, hypoid drives, they have supplied literally millions of crown wheels and pinions, differentials and complete axles to British and European vehicle makers. E.N.V. have production and heat treatment facilities for quantity production of final drives, axles, gearboxes and associated transmission components, and offer co-operation with vehicle designers from the project stage.



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FOR ABSORBING AND MEASURING  
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MOVERS - SIZES RANGE FROM 50  
TO 60,000 B.H.P. AND UPWARDS

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at BRITISH RAILWAYS'  
RUGBY TESTING STATION.  
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each of 1200 B.H.P.  
capacity were incorporated.

Write for further particulars:

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**almost limitless possibilities of saving in time and cost**



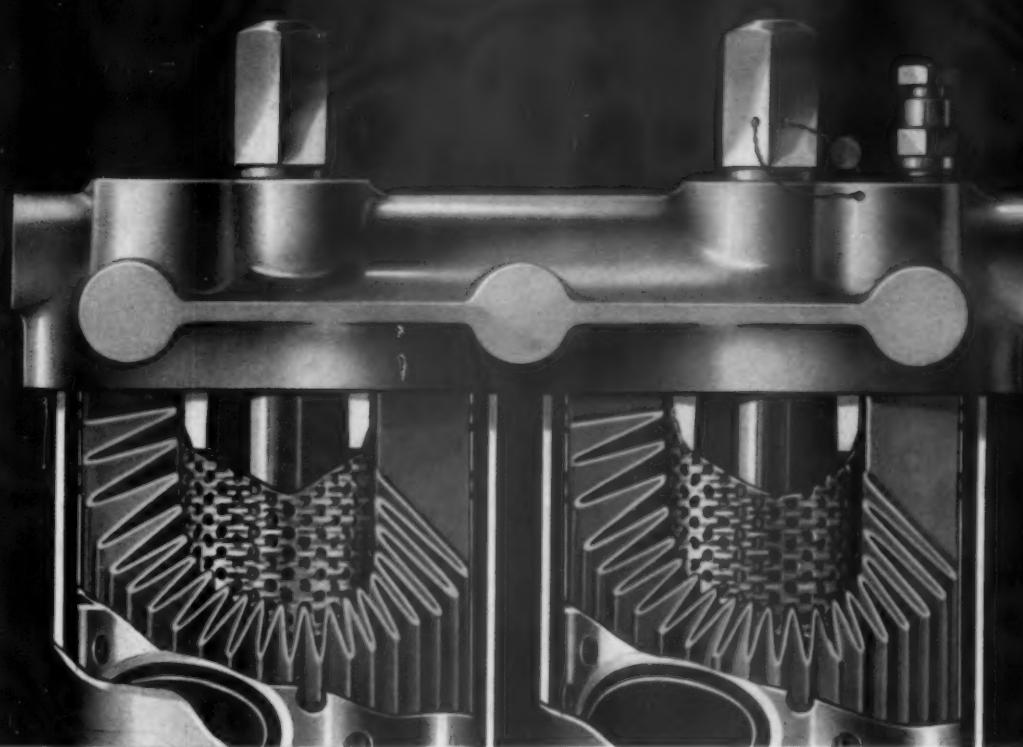
# **screw thread inserts**

Heli-Coil Inserts are self-locking thread liners made from high tensile stainless steel wire. In tapped holes they provide a conventional thread with higher loading strengths and greater resistance to wear and stresses than unprotected threads. The Heli-Coil eliminates stripping, seizing, galling and corrosion. It literally *armours* the thread. The Heli-Coil offers a unique opportunity for product cost revision. It is "a natural" for automation, it can make dramatic cuts in time and labour costs. Assembly is the ultimate in simplicity—just drill, tap and install. The Heli-Coil saves weight and space. It improves the serviceability and appearance of the end product. We suggest you write soon for data on Heli-Coil, the British-made Insert that is available internationally. It is a product of the day and this atomic age.

For further details write for Sales leaflet H.E.2.

**ARMSTRONG PATENTS CO. LTD. EASTGATE, BEVERLEY, YORKSHIRE**

 HELI-COIL is a registered trade mark



## TWO FILTERS IN ONE



Each of the two bowls contains its own filter element, and is connected to a common head, thus simplifying pipe work. The filter is made in two types:

**DOUBLE 'MICONIC'** As shown above, 'Micronic' elements are used in both stages; the second one being sealed to discourage unnecessary interference. This arrangement is most helpful where unskilled labour is employed as it eliminates the possibility of damage being caused by dirt introduced during element changes.

**METAL & 'MICONIC'** A metal edge element of .002" spacing is used as a primary filter to prevent the larger particles of dirt from reaching the extra fine Micronic second stage element. The life of the 'Micronic' element is thus greatly increased and less maintenance is required.

*These filters are available for flow rates of up to 10 G.H.P.*

AUTOMOTIVE PRODUCTS COMPANY LIMITED, LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

**ORIGINATORS OF PAPER FILTER ELEMENTS**

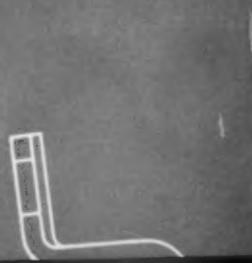
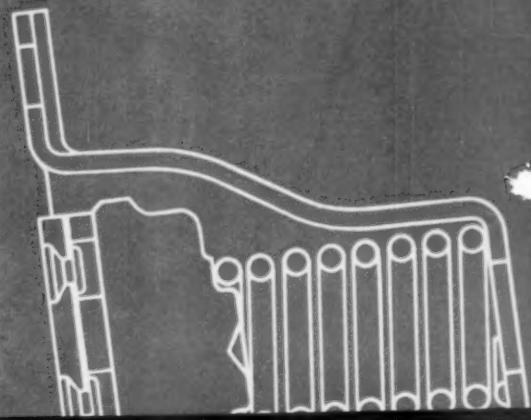
**PUROLATOR**

Regd. Trade Marks:  
Purolator, 'Micronic'

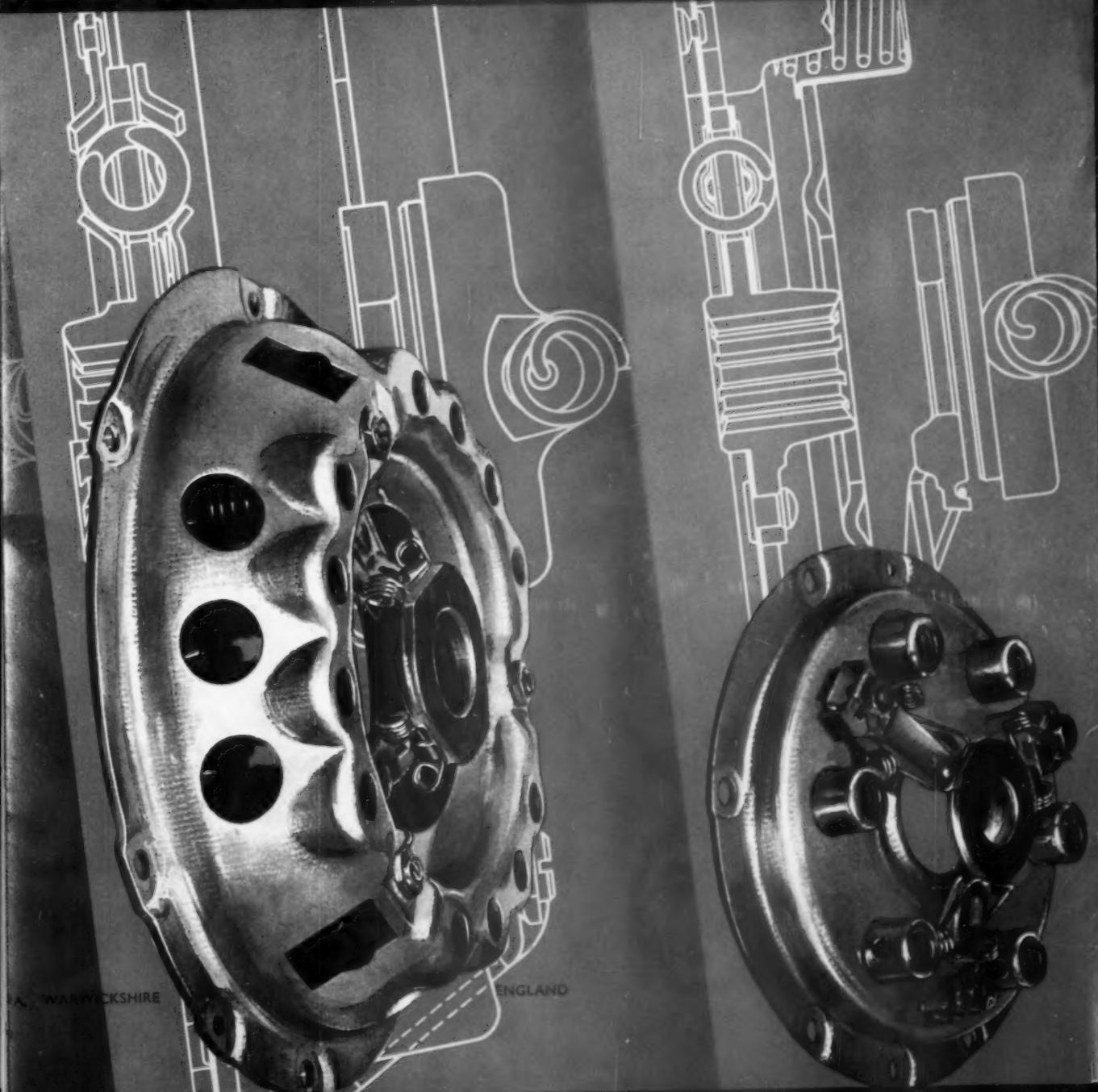
**'MICRONIC' LUBRICATING OIL, FUEL AND AIR FILTERS**

**BORG & BECK CLUTCHES**

BORG & BECK COMPANY LIMITED  
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**FOR ALL REQUIREMENTS**



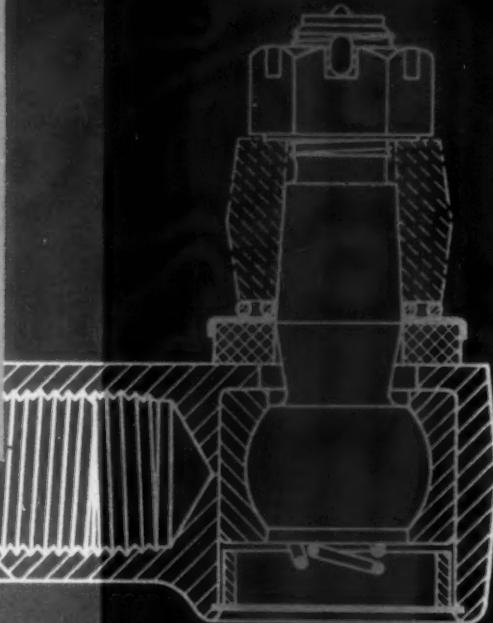
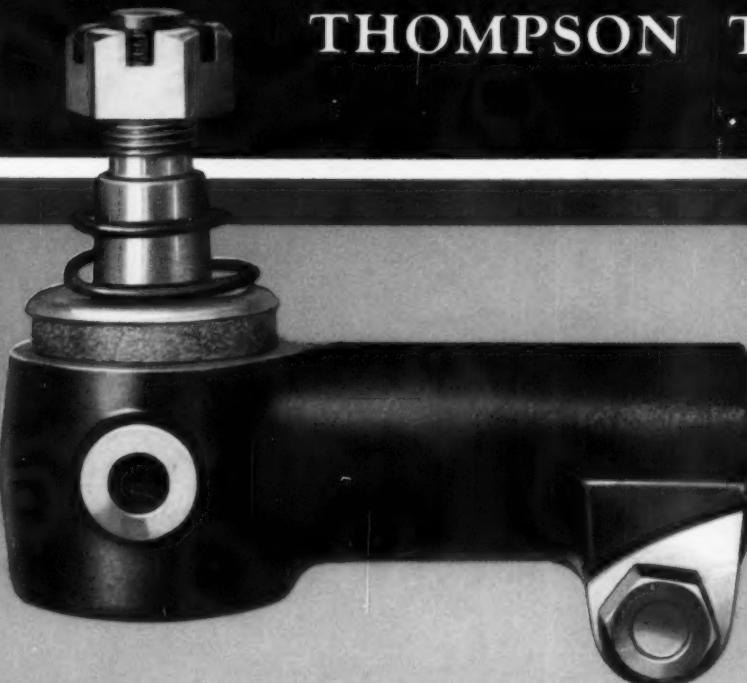
TON

W. WARWICKSHIRE

ENGLAND

# THOMPSON TIE-ROD

...the eccentric type



The eccentric Thompson Tie Rod automatically adjusts itself, thereby taking up all backlash.

The sectional line drawings show the effective and simple construction. Two half bearings, with external cylindrical surfaces fitting in the socket body have partly spherical recesses embracing the ball pin. These recesses are eccentric to the outside surface, so that under the action of a spring these half bearings exercise a self-adjusting action.

This action is so calculated that the self-adjustment is irreversible, so that the joint cannot be slackened by the ordinary working forces imposed upon it.

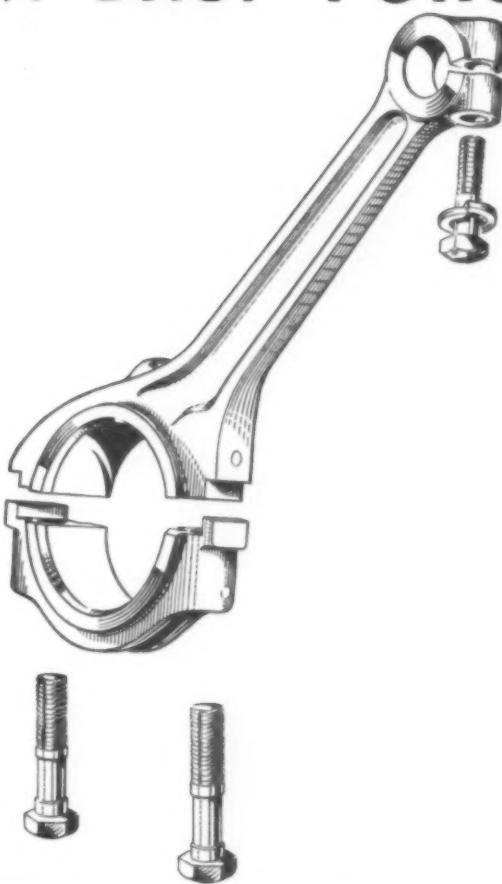
These ball joints are made in various sizes to suit front axle weights up to 8,500 lb.

AUTOMOTIVE PRODUCTS COMPANY LIMITED  
LEAMINGTON SPA • WARWICKSHIRE • ENGLAND

**Thompson**  
**Self-adjusting**  
**STEERING ROD ASSEMBLY**

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## QUALITY STEELS FOR DROP FORGINGS



**black bars  
for  
connecting rods**

THE PARK GATE IRON & STEEL COMPANY LIMITED ROTHERHAM  
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TELEGRAMS: YORKSHIRE, PARKGATE, YORKS



Putting two and two together and making five ! At least, that's how it appears when you consider the saving in time and cost by changing over to tapping screws. Without doubt, the tapping screw does display a number of very definite advantages over the conventional machine screw. It obviates the use of nuts. With its self-locating point, it forms its own thread and eliminates a separate and expensive tapping operation. It makes for easier assembly, is stronger, cheaper and faster. And when used in conjunction with the Phillips recessed head, designed for power driving without damage to either work or worker, it is obviously safer. Putting two and two together, the tapping screw simply ensures a better job. Why not change over to tapping screws and prove it for yourself?

**Linread**

*tapping screws for economy and safety*

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SLOTTED AND PHILLIPS RECESSED HEAD MACHINE SCREWS AND TAPPING SCREWS • HIGH TENSILE HEXAGON HEAD BOLTS AND SETSCREWS  
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...but the best way that we've found is quite simply to do the job exactly as it's wanted, and by the time it's wanted. If this is the service you're looking for, get in touch with:

**Metropolitan Plastics Ltd**



*Specialists in thermo-setting plastics*

Glenville Grove, Deptford, London SE8  
Telephone: TIDeway 1172

# THEY CAN CAN COAL IN FRANCE



Charbonnages de France (the French coal authority) have found a clean, easy way to deliver coal—by packing it in corrugated sheet steel. This pack is a specially designed triangular jerrican holding 33 pounds of coal. The coal is delivered in the can, to be tipped from it straight into the stove or grate, thus avoiding the dusty, dirty shifting of coal from sack to cellar to scuttle to fire.

#### STEEL'S VERSATILITY

This is only one example of the many uses of sheet steel. Others more familiar (though no less enterprising) include sheet steel for railway carriages and wagons; guttering and steel ducting; kegs, drums, cans and cisterns; oil stoves, washing machines, refrigerators and office furniture.

The motor car industry in particular has used the increasing versatility of sheet steel to good advantage. The strength and flowing lines of today's motor car body reflect the continuous improvement in steel qualities to suit modern press shop practice.

#### CONSISTENT QUALITY

Powerful presses shape a flat sheet of steel in smooth curves and crisp contours forming body panels, wings and doors—strong, light and free from distortion. Pressings such as these with their bold moulding and intricate detail require steel of consistent quality and ductility.

By its concentration on the wide continuous strip mill process, The Steel Company of Wales has been able to supply such steel in the necessary quantity, thus making a substantial contribution to the development of the motor car industry.

#### INCREASING QUANTITY

The Steel Company of Wales was specifically formed to meet the growing demand for high quality steel of this type and it already makes over one-third of Britain's sheet steel. Research and development continue: new plant, planned and under construction, will push production up and up.

It has always been the policy of The Steel Company of Wales to pay particular attention to customers' specific problems, and to ensure that its products are "tailor-made" to individual requirements. If you have an industrial problem which sheet steel might help to solve, it will be worth your while to write to us or telephone Port Talbot 3161. We believe we can help.



## THE STEEL COMPANY OF WALES LIMITED

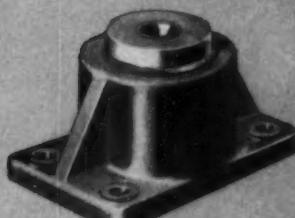
Steel Division: Abbey Works, Port Talbot, Glam. Telephone: Port Talbot 3161. Telegrams: Steel, Port Talbot



General type  
(triangular flange)



Pedestal assembly



Pedestal mounting



Prustacon type



FN type



Instrument type  
(pedestal flange)



Instrument type (square flange)



Ring-stud  
mounting

Bonded stud  
mounting



'SILENTBLOC' rubber-metal mountings are the accepted means of insulating almost anything from vibration—from small and delicate instruments to multi-ton drop-hammers. If you have a vibration problem, bring it to us as pioneers and far and away the leaders in the use of rubber in engineering. Technical information always available from *Silentbloc Limited, Manor Royal, Crawley, Sussex. Telephone: Crawley 2100.*

## MOUNTINGS by **SILENTBLOC**

ANDRE RUBBER CO. LTD. — A SILENTBLOC COMPANY

**Pioneers of Rubber in Engineering**



**PETERMANN AUTOMATIC**

**6X6**

## **6 TRANSVERSAL TOOLS AND 6 TOOLING POSITIONS ON THE TURRET**

The multiple combinations available with this arrangement offer solutions to a considerable number of machining problems.

This is just one feature of the world-famous Petermann Automatic Screwing Lathes P.16 and P.25.

For illustrated literature giving details of all the features of these and other Petermann machines please write to:



**CHARLES CHURCHILL AND COMPANY LIMITED**

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## Self-locking Nuts

NEVER LOSE THEIR GRIP



Continue to rely on **PHILIDAS**

These one piece nuts are of all-metal construction—with no insert. They stay secure under extremes of temperature and against all vibration—and can be used time and time again.

*Most types and sizes available from stock*

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**For the brilliance  
that lasts and lasts . . .**

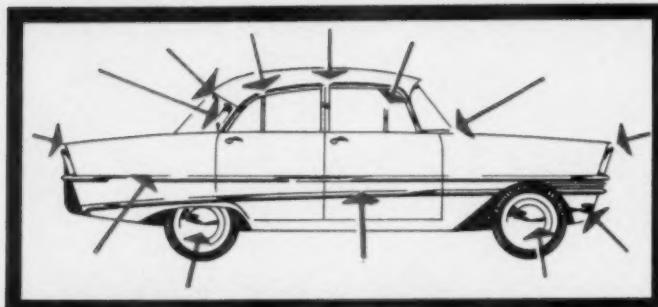
**TRUBRITE  
Stainless Steel**

*the car trim of to-day and of the future*



**THE MOTORIST says:**

Trubrite keeps its beauty so much longer than other trim materials, and saves me work in cleaning. It resists scratches, never corrodes, and maintains the value of my car.



**THE DEALER says:**

Trubrite, with its time-proof brilliance, strength, and easy maintenance, makes an instant appeal in the showroom. It also helps me clinch those vital marginal sales.

Sparkling beauty enhances styling of modern cars  
Cannot rust, peel or chip. No pitting.  
More strength—resists scratches and denting.  
Bright right through.  
Easy to clean (using only soap and water)  
Time-proof brilliance keeps up value of car.  
Already adopted for many parts both outside and in by leading manufacturers, such as Vauxhall, Morris, Wolseley, Riley, etc.



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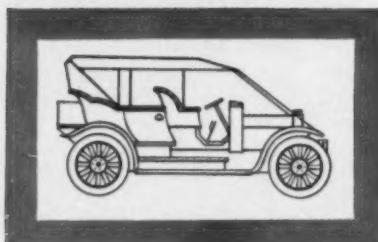


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DORMER DRILLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS



*Sterling achievements  
span the history of an era*

... and help to make that era memorable.

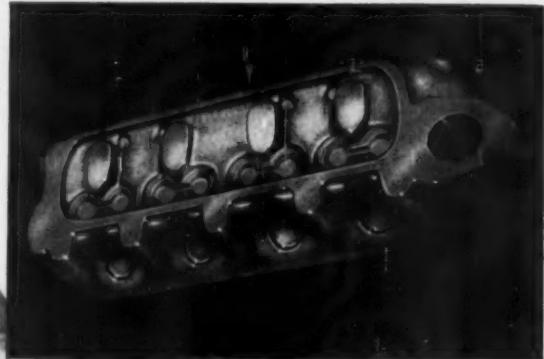
The continuing success of Sterling Metals is due to their ability to supply castings of the highest quality in the desired quantities at the right time.

Today as in the past, Sterling Metals offer the greatest technical experience augmented by quality control of production which is second to none.

Sterling Metals are the acknowledged experts in casting aluminium and magnesium alloys by sand, die and precision mould processes, and in making engine blocks and cylinder heads in high duty iron.

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Cast iron cylinder head  
for Austin A35 car.  
By courtesy of Austin Motor Co Ltd.



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Whatever type  
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## GIRLING BRAKE SYSTEM

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Backed by 25 years experience



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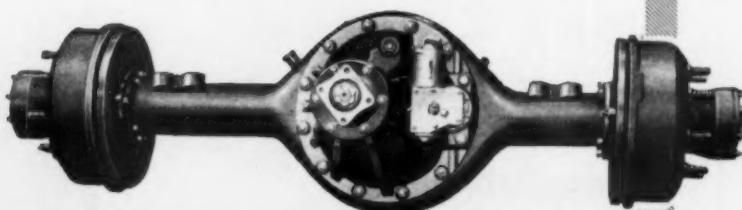
**KEW  
DODGE**



*with* **EATON**  
**2-SPEED AXLES**

Eaton two-speed axles give speed with economy when the load is light and the going easy and also extra pulling power for big loads and difficult operating conditions. The right gear is right there whatever the conditions and there is no need for slogging uphill or over-revving. That is why Dodge specify the Eaton two-speed axle as standard on all their tractor models and as optional equipment on most of their load-carrying vehicles.

Eaton have combined two complete power ranges into one unit, and a fingertip control located on the normal gear change lever makes either range instantly available as the need arises. Wear and tear on engine and transmission are reduced—maintenance costs lowered—fuel consumption cut considerably. Valid reasons for ensuring that your new vehicles are fitted with Eaton two-speed axles.



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EA 87a

# Unique



"Newallastic" bolts and studs have qualities which are absolutely unique.

They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method.

**A. P. Newall  
& Co., Ltd.**  
POSSIL PARK GLASGOW • N

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# Wellworthy AL-FIN armoured ring groove pistons

*... more than pay  
for themselves  
in the first year!*

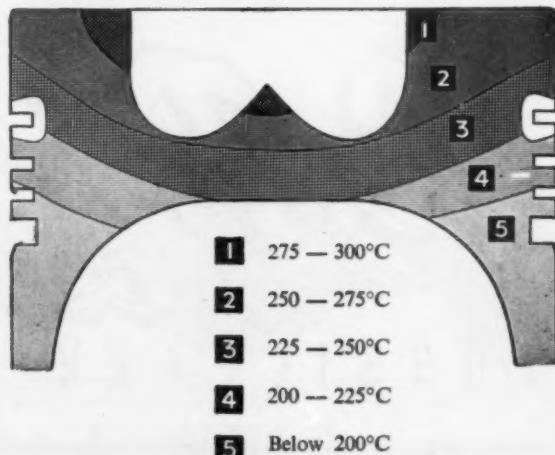
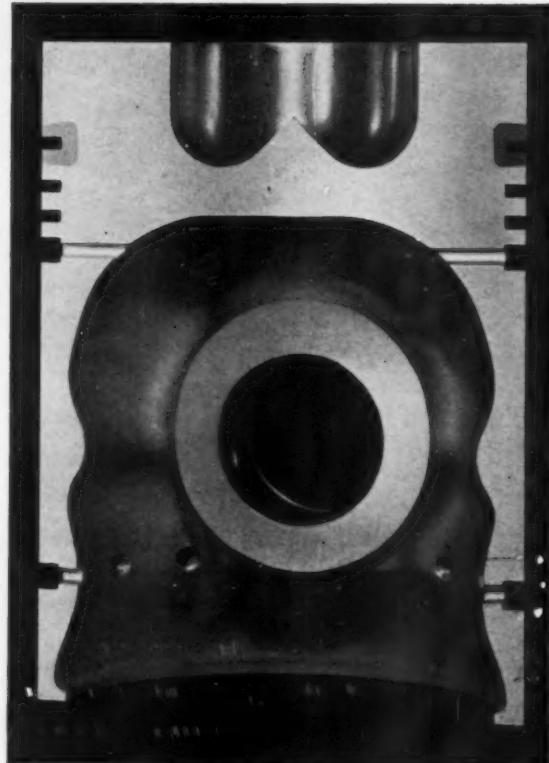
The top ring groove of the Al-Fin Piston has an austenitic cast iron insert bonded to the alloy giving strength where it is most required. This iron bonded securely to the alloy during the casting of the piston will stand up to the most severe usage. That means piston life is increased by at least 100%. This double mileage saves you the cost of one overhaul *and* the cost of another set of pistons!

*Write for leaflet A20/11*

## Isothermal Piston Design.....

Wellworthy use Isothermal Survey in diesel engine piston design to ensure:

- Correct selection of materials.
- Determination of correct running clearances.
- Avoidance of localised hot areas.
- Correct gudgeon pin alignment.
- That head thickness, coupled with correct blending into piston wall overcomes distortion of ring grooves. This has considerable bearing on blow-by and efficient oil control.



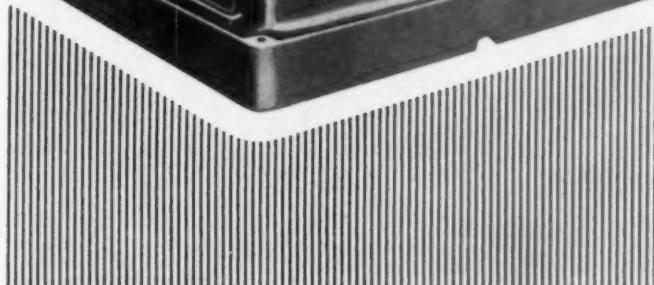
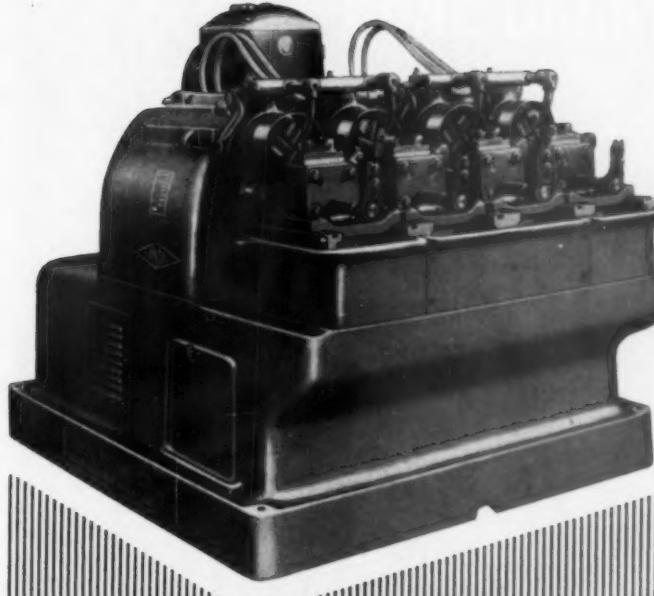
WELLWORTHY LIMITED · LYMINGTON · HANTS

# LANDIS 4-SPINDLE SEMI-AUTOMATIC THREADING MACHINE

*Speed of threading bolts, studs and rods.*

*Simplicity of setting and operation.*

*Ease of maintenance.*



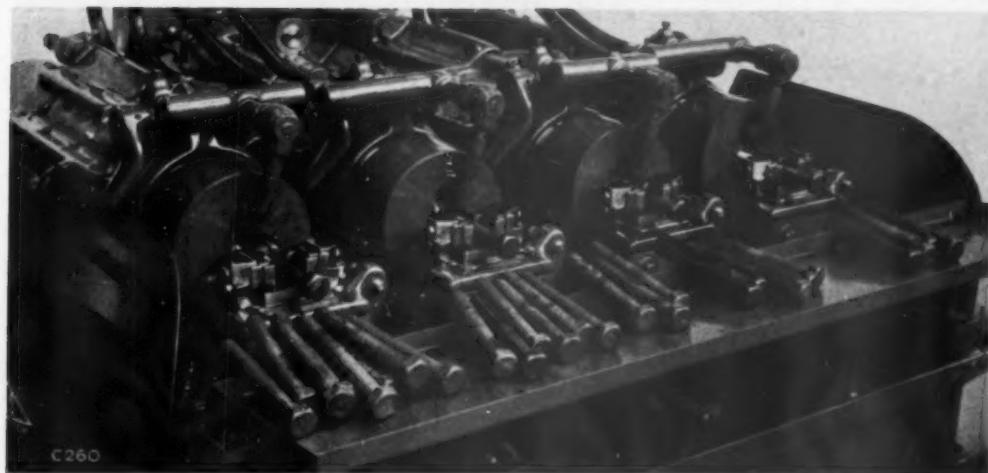
For the high production threading of bolts, studs and rods. Two sizes for threads from  $\frac{1}{8}''$  to  $\frac{3}{8}'' \times 3\frac{1}{2}''$  long and  $\frac{1}{2}''$  to  $1'' \times 3\frac{1}{2}''$  long.

The operator simply loads and unloads the grips as they automatically open. Production ranges from 500 to 2,000 per hour, depending on diameter and thread length. Standard or special gripping mechanism fitted.

The slow spindle speed feature of this machine increases the life of the chasers.

*The illustration below shows :*

Cutting  $\frac{1}{8}''$  diameter by  $1\frac{1}{2}''$  long Whit. threads on black bolts. Production, 1,650 bolts per hour. Rate of production largely depends on the speed of the operator loading and unloading the grips.



ALFRED

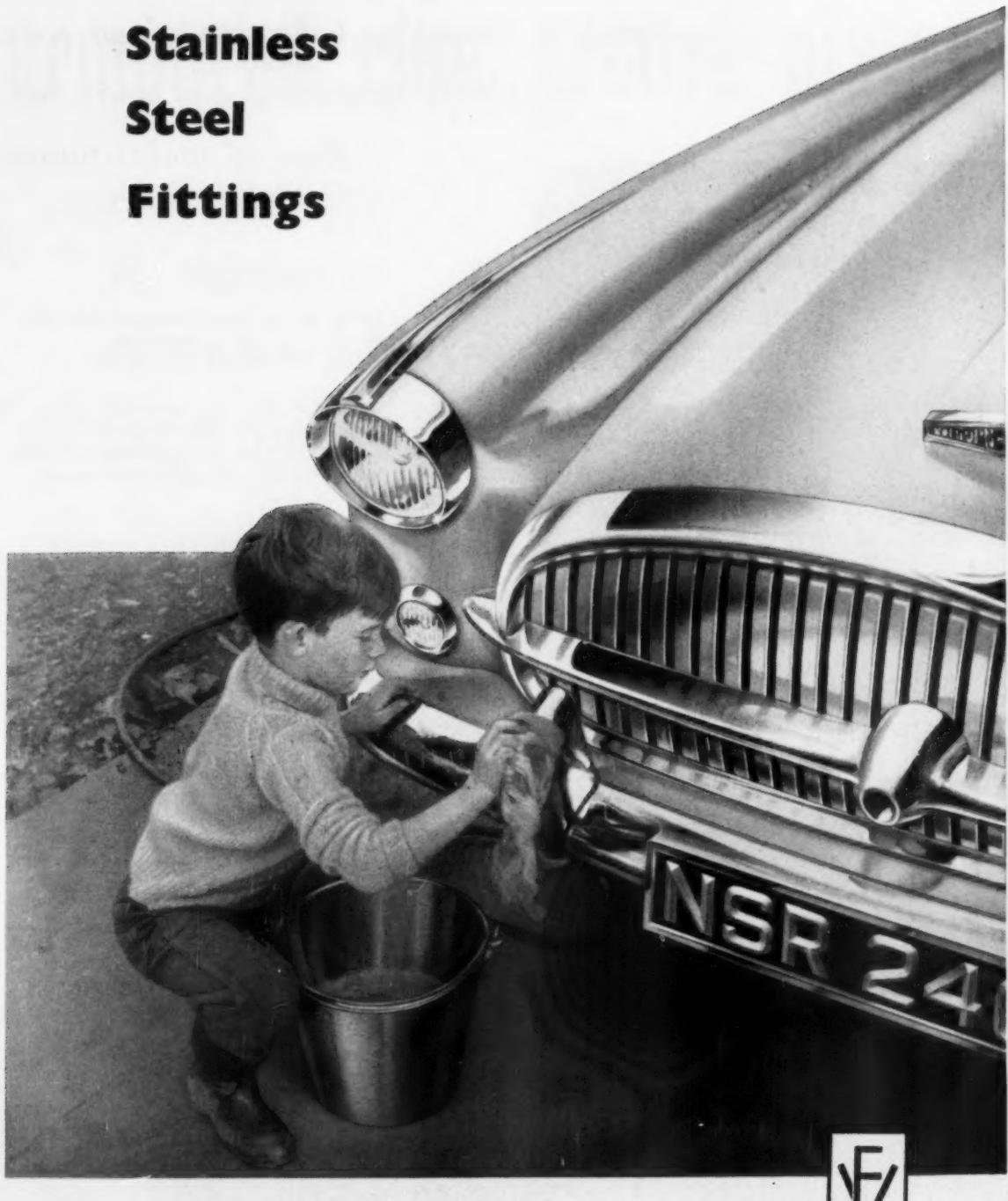
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LTD., COVENTRY Factored Division, Red Lane Works.



AD 351

tomorrow's motorist  
will insist on  
**Stainless  
Steel  
Fittings**



*Issued by the makers of the famous 'Staybrite' Stainless Steel*

**FIRTH-VICKERS STAINLESS STEELS LTD. SHEFFIELD**

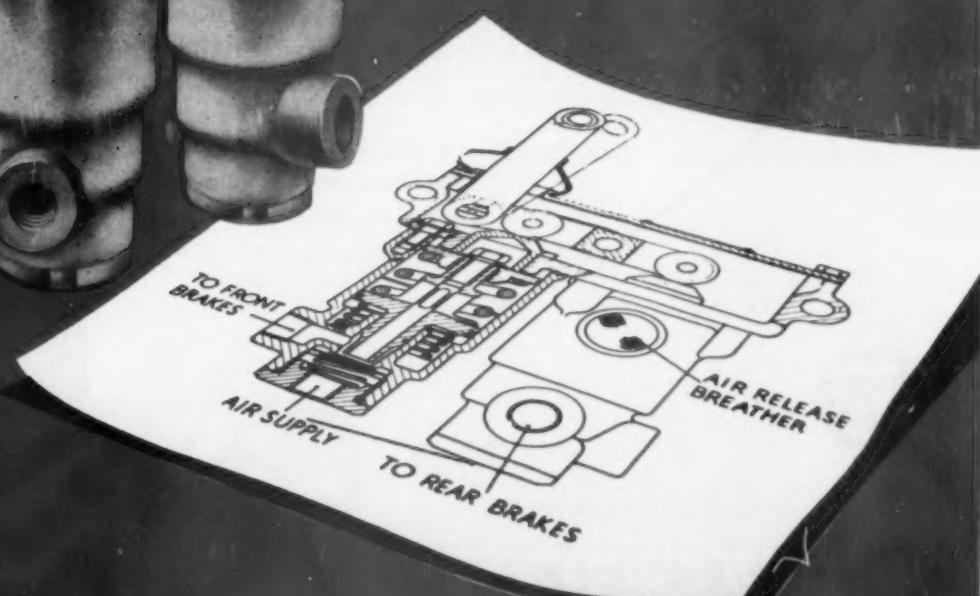


**SAFETY** with a new CLAYTON DEWANDRE

## DUAL BRAKE VALVE

COMPACT · LIGHTWEIGHT

The new Dual Brake Valve, developed by Clayton Dewandre Company Limited, represents an important step forward in road safety. Comprising two Bendix-Westinghouse Type 'E' Brake Valves in a common housing and operated simultaneously through a balanced beam by a fulcrum lever connected to the brake pedal, the assembly provides individual but matched control of the front and rear brakes. In the event of a failure in one part of the system the remaining section will continue to function in the normal way.

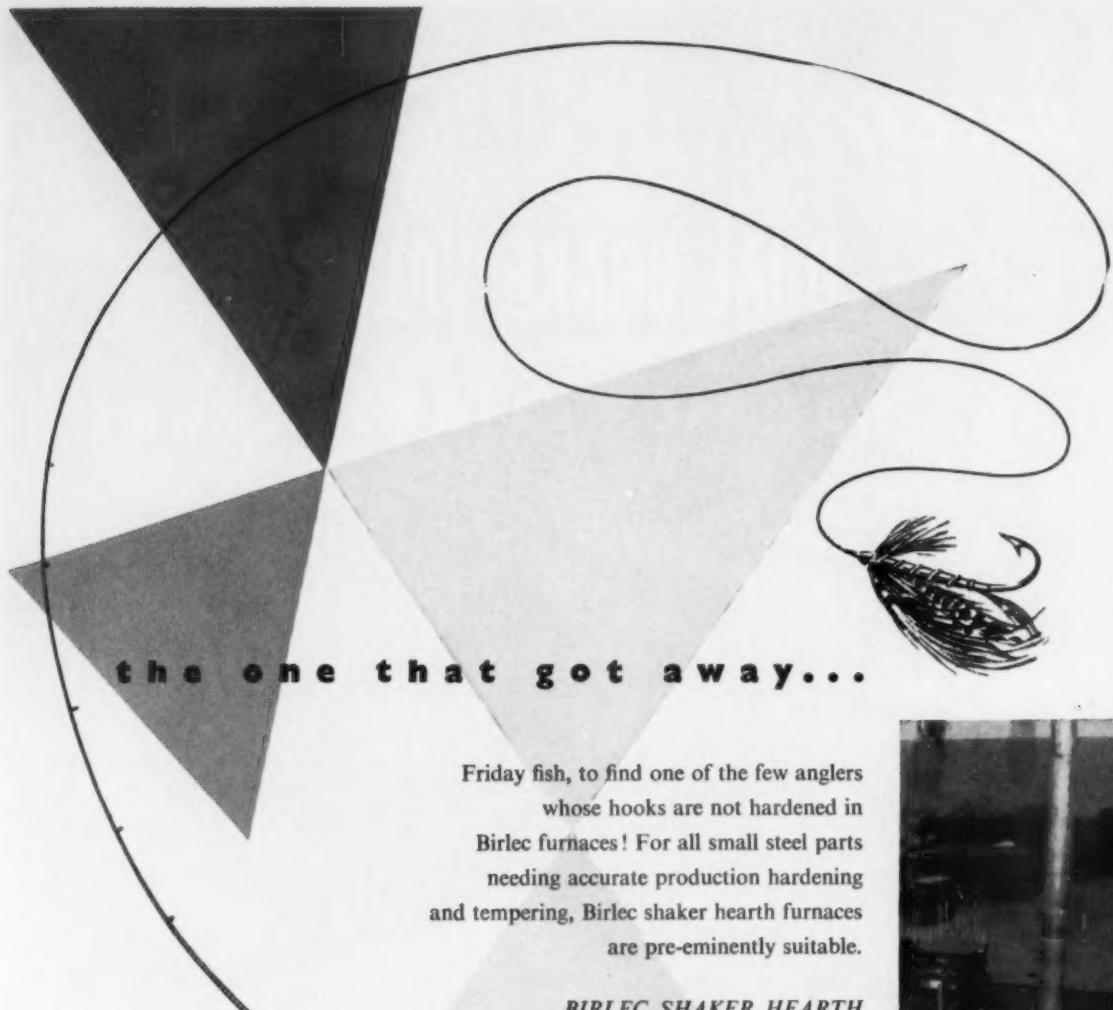


**CLAYTON DEWANDRE CO. LTD.**

TITANIC WORKS, LINCOLN, ENGLAND, M.L. 2. 02000. V. 2



AP-32



the one that got away...

Friday fish, to find one of the few anglers  
whose hooks are not hardened in  
Birlec furnaces! For all small steel parts  
needing accurate production hardening  
and tempering, Birlec shaker hearth furnaces  
are pre-eminently suitable.

**BIRLEC SHAKER HEARTH**  
*furnaces are available in standardised  
capacities with appropriate non-scaling,  
non-decarburising atmosphere control.*



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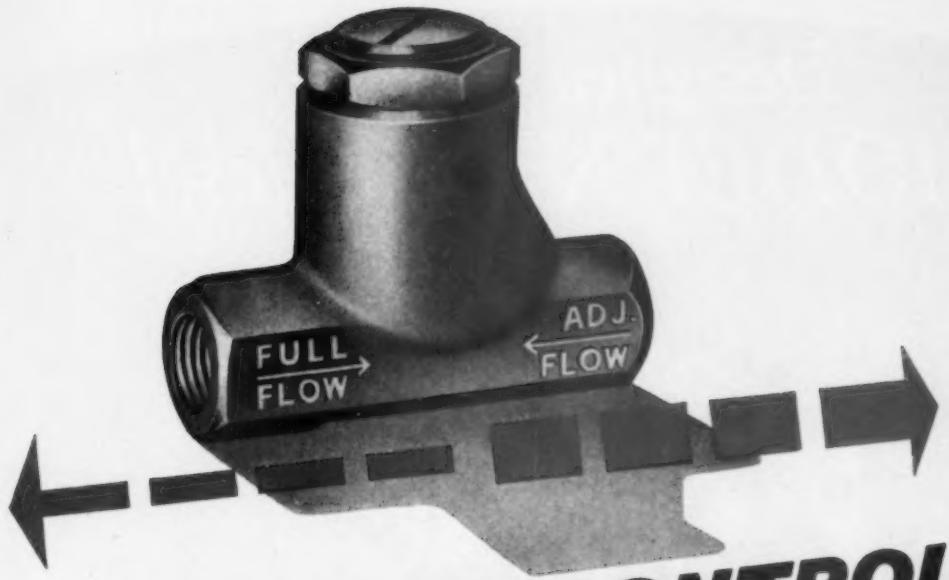
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## FLOW CONTROL

SCHRADER FLOW CONTROL VALVES provide a control of movement speed so essential to the effective use of compressed air equipment. The range of valves has now been extended to give even greater flexibility.

The valve is easily set, by means of an adjustment screw, thus determining how fast the air flows in the "adjusted" direction. If used in conjunction with an air cylinder, for instance, the valve can control the pressure build-up and with it the *speed* of the piston thrust, but not its pushing force. This controlled thrust speed avoids the impact shock of suddenly applied air pressure, yet permits full thrust force. When the valve is operating in the "full flow" direction a poppet is opened, giving open line pressure. Where controlled air flow is required in both directions, two valves can be fitted back-to-back.

Although designed primarily for air control, these valves are equally suitable for use with oil or water in hydraulic systems.

*Body of cast brass.  
Non-corrodible plunger assembly,  
replaceable in one unit.  
Substantial lock-nut  
resists vibration.*

The  $\frac{1}{2}$ " bore valve is the latest addition to the Schrader range, which now covers  $\frac{1}{4}$ ",  $\frac{3}{8}$ " and  $\frac{1}{2}$ " B.S.P. sizes. These provide a pressure range as follows:—AIR: 0-400 P.S.I. OIL or WATER: 0-800 P.S.I.

# Schrader

## FLOW CONTROL VALVES

POST THIS COUPON TODAY

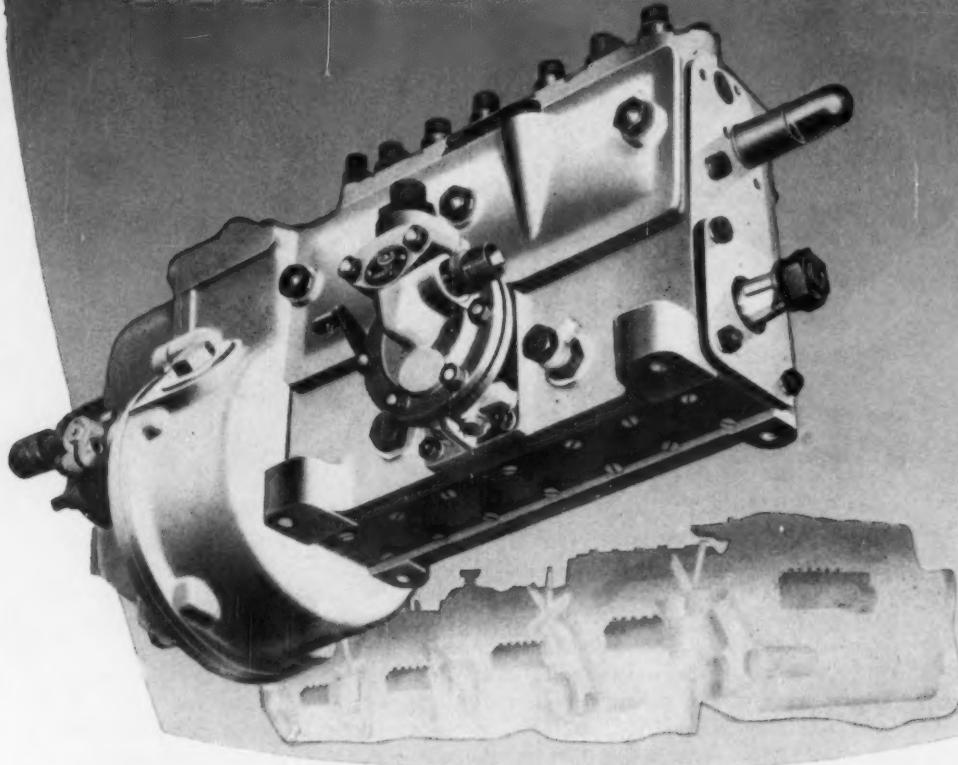
To: A. SCHRADER'S SON, Air Control Products Dept. A.E.,  
829 TYBURN ROAD, ERDINGTON, BIRMINGHAM, 24

Please send details of Schrader Flow Control Valves

NAME.....

ADDRESS.....

*Designed for the*  
**MODERN** *HIGH SPEED Diesel*



The C.A.V. 'N' type fuel injection pump was specifically designed for duty with the higher speed, higher pressure, larger output engines of today.

It was developed in the light of accumulated experience of fuel injection equipment, with unrivalled technical and engineering resources avail-

able for the investigation and solution of the many problems involved.

Improved features include shorter, stiffer camshaft, through bolt, flat base fixing, increased bearing areas, built-in final filter, improved delivery valve joints, positive phasing adjustments, etc.



*The World's Leading Manufacturers of*  
**FUEL INJECTION AND ELECTRICAL EQUIPMENT**

C.A.V. LIMITED · ACTON · LONDON · W.3

AP 916



Good braking starts...

...and ends with **FERODO**  
Anti-Fade Brake Linings

FERODO LIMITED • CHAPEL-EN-LE-FRITH      A Member of the Turner & Newall Organisation

Top men, Shop men,  
fast-coming-up-men  
For weldability call for Group 2  
But Group 3's slag removal  
Earns the welder's approval;  
They're combined  
in the new. . .

# VELVARC TWO



The new Velvare Two electrode, with thirty years of ACTARC experience behind it, combines the excellent weldability of Group 2 electrodes with the good slag removal of Group 3.

Write for details of the full range of ACTARC welding transformers and plant, welding electrodes for all purposes and welding accessories.

## ACTARC

*the name for dependable electrodes*

**ARC MANUFACTURING CO. LTD.**

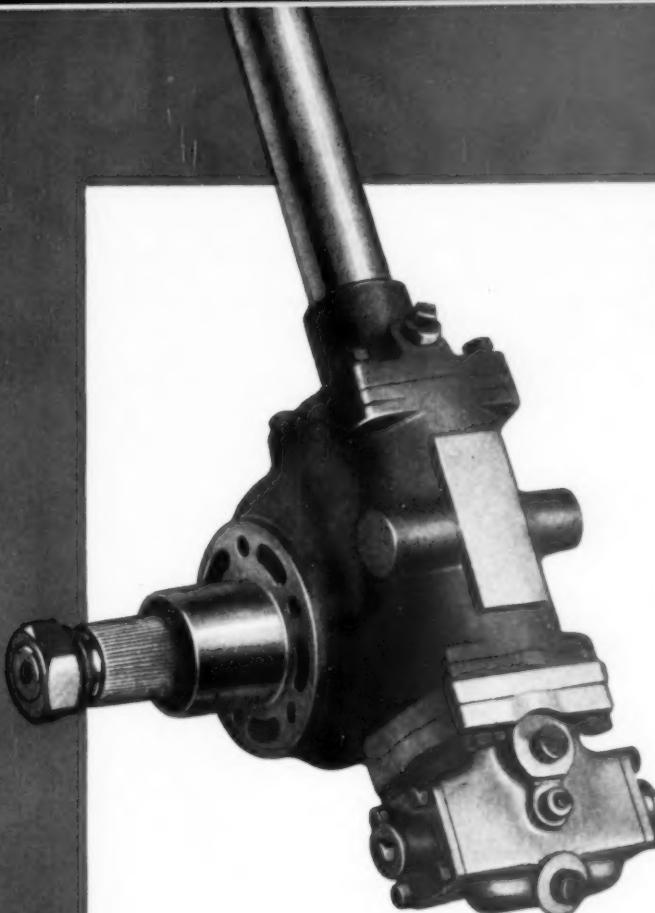
ACTARC WORKS · NITSHILL · GLASGOW, S.W.3.

Telephone: BARRHEAD 2293/7

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LONDON OFFICE: 15 HERCULAN ROAD, HILLINGDON, MIDDLESEX, Telephone Uxbridge 5651/2

E 24



Interchangeable, on the same  
mounting, with the standard  
Marles manual gear unit.

## THE TYPE 3 'UNIVERSAL' UNIT

Illustrated above is the Type 3 'Universal' steering gear which incorporates the hydraulic control valves mounted upon our type '861' manual gear. This is for use with a separate power pump and with power cylinders operating on the steering linkage. Further particulars will be sent on request.

ADAMANT ENGINEERING CO. LTD.,  
THE AERODROME, WOODLEY, Near READING.  
*Sole proprietors of the Marles Steering Company Ltd.*  
Telephone: Sonning 2351      Telegrams: Adamant, Reading

# MARLES

Top men, Shop men,  
fast-coming-up-men  
For weldability call for Group 2  
But Group 3's slag removal  
Earns the welder's approval;  
They're combined  
in the new. . .

# VELVARC TWO



The new Velvarc Two electrode, with thirty years of ACTARC experience behind it, combines the excellent weldability of Group 2 electrodes with the good slag removal of Group 3.

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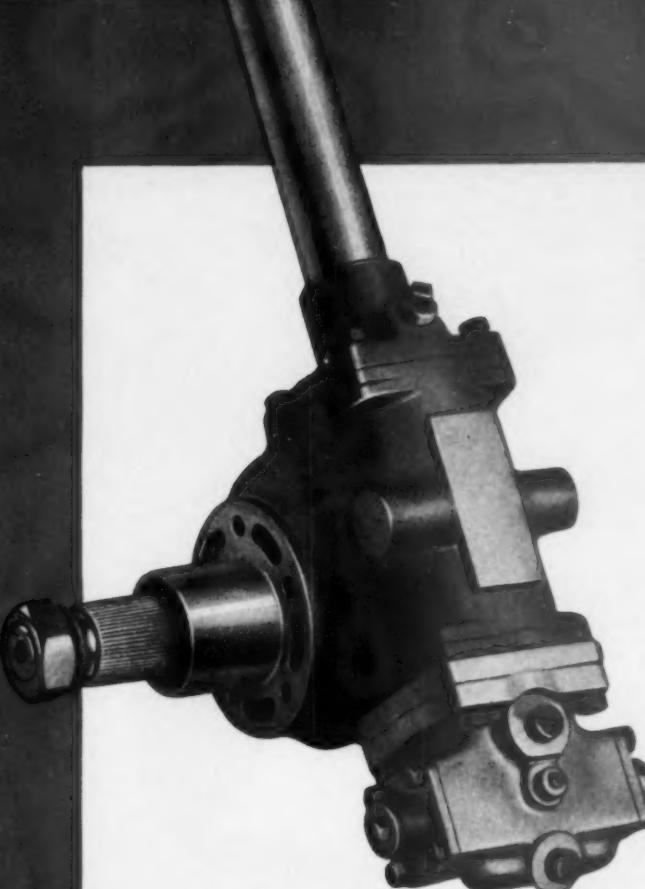
ACTARC WORKS • NITSHILL • GLASGOW, S.W.3.

Telephone: BARRHEAD 2293/7

Telex: ACTIVARC GLASGOW

LONDON OFFICE: 55 HACCIER ROAD, MILLINGDON, EBBW Vale, Telephone: GLOUCESTER 5451/2

E 24



Interchangeable, on the same  
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THE AERODROME, WOODLEY, Near READING.

*Sole proprietors of the Marles Steering Company Ltd.*

Telephone: Sonning 2351

Telex: Adamant, Reading

# M A R L E S



## R&M help to put Britain's cars ahead

*I've been working on car-engine design for 25 years, and Ransome & Marles bearings have always been specified. I suppose you've contributed to the motor industry for much longer than that?*

The motor industry was, in fact, one of the earliest users of R&M products. For just half a century, bearings have been produced at Newark for nearly every British make of car, as well as for commercial vehicles, motor-cycles, auto-cycles, trailers and so on.

*And for car accessories?*

Certainly. Even brakes and lighting equipment are manufactured on machines which rely on our bearings. And now we are rapidly extending our contribution to the motor industry. It has been estimated that the turbo-driven car will be an economic possibility within two years: with our long experience in designing and manufacturing bearings for gas turbines, we expect to play a prominent part in turning this possibility into a reality. Our

research people are fully conversant with all aspects of producing bearings for turbines, and are working continually in this field. Research is also going on into the uses of new materials such as plastics and sintered metals. Our aim is to match the automobile designer's objectives with the most advanced standards of design and production in our bearings.

*What about the work Ransome & Marles are doing on bearings for the engines in today's cars?*

That's still going on, naturally. With the advent of very high compression engines we have been tackling many new problems—and solving them, too. And the introduction of automatic transmission systems in this country has involved us, in production as well as in research. In fact, you can say that R&M have a hand in every technical development of Britain's motor industry, and will continue to have in the future.

**Ransome & Marles Bearing Co. Ltd., Newark-on-Trent, England**

Telephone: Newark 456; and Telex 37-306





# MAXIPILOT

AUTOMATIC  
MULTI-CYCLING  
HYDRAULIC  
COPYING LATHE

*for fast, accurate  
high-output production*

All the components shown below can be automatically produced at fast rates and with high accuracy by copy turning on the Drummond Maxipilot Hydraulic Automatic Multi-cycling Copying Lathe.

This rigid and powerful machine has been designed to exploit to the maximum the cutting possibilities of carbide tools on medium and large quantity production runs. Top speed is higher than usual for a machine of this size and special attention has been given to the elimination of all vibration.

The Maxipilot is made with 20 in. or 32 in. between centres and maximum swing 16 in. over bed; 9 in. over the cross slide. Write today for full details.

**DRUMMOND BROS. LTD.**  
GUILDFORD · ENGLAND



Sales & Service for ...

**DRUMMOND-ASQUITH**

... the British Isles

**DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM**  
'Phone: Midland 3431 (7 lines) 'Grams: Maxishape, B'ham. Also at LONDON: 'Phone: Trafalgar 7224 (5 lines) and GLASGOW: 'Phone: Central 0922

D262

# What do Desoutter do?

In response to an urgent appeal from the M.D. a careful survey, designed to discover the impact of 23 years' advertising, has recently been completed. In this nation-wide survey thousands of people were asked, "What do Desoutter make?"

2% said "Miniature Horses"

3% said "Hair Restorer"

0.5% said "Weak Jokes"

94.5% "Didn't Know"

The M.D. was most displeased. "I'm not suggesting," he said, "that our advertising hasn't done a quite subliminal job on their collective unconscious, but in one respect at least it may be said to have failed. Let us correct this now, gentlemen:

## **DESOUTTER BROS LIMITED**

### **make Pneumatic**

(i.e. driven by air)

### **and Electric**

(i.e. driven by electricity)

### **Power Tools**

(i.e. tools which for the purpose of this argument are driven by air or electricity)



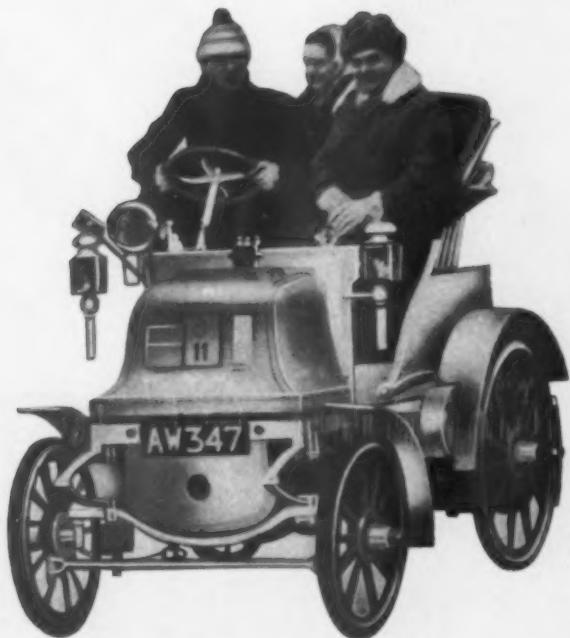
**Desoutter Brothers Limited, The Hyde, Hendon, London, N.W.9.**

CRC 308

# KIRKSTALL AXLES

WERE FITTED  
TO THIS  
1897  
DAIMLER

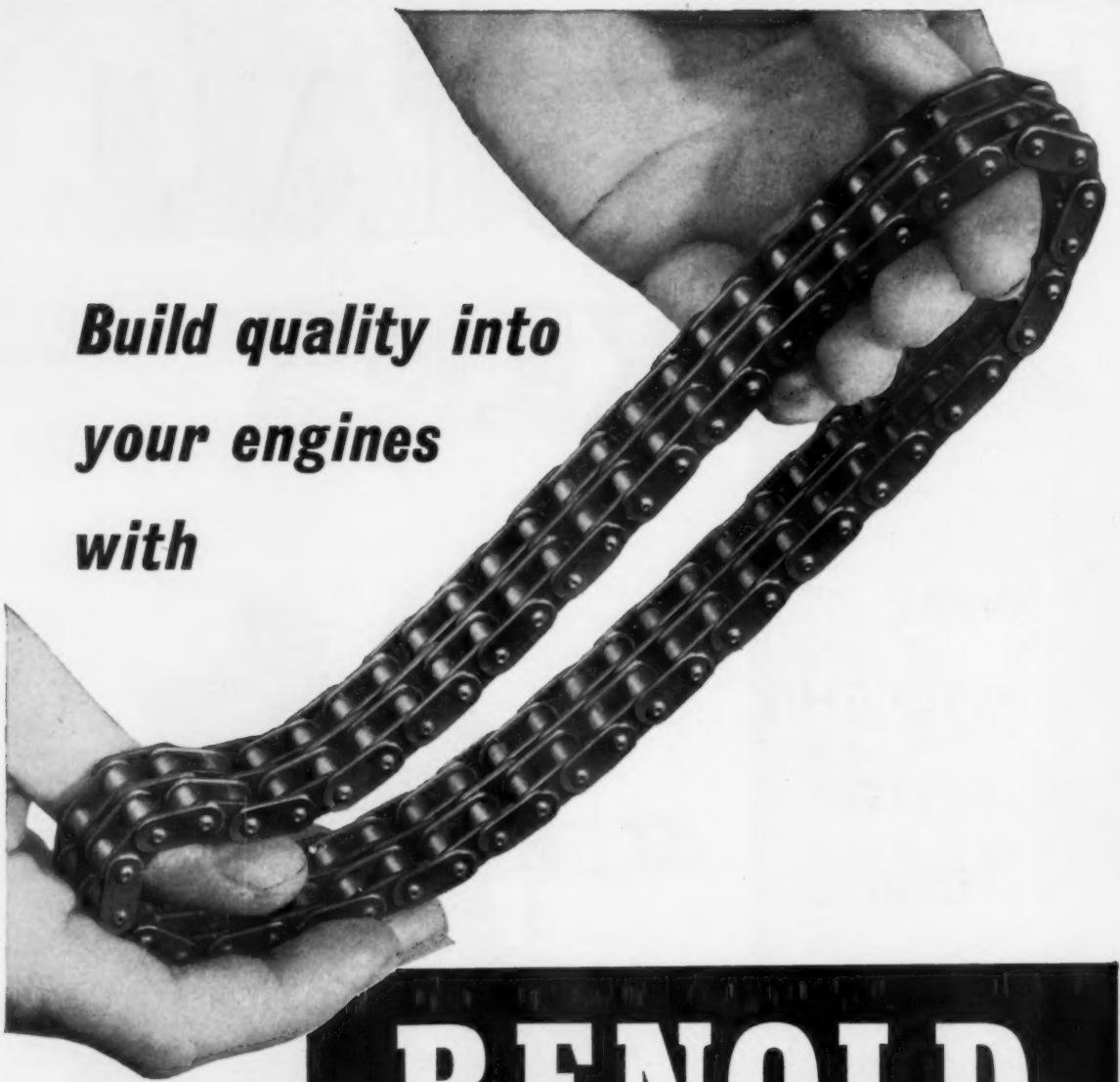
THEY ARE USED TODAY  
ON THE WORLD'S  
BEST COACHES,  
BUSES, TRUCKS,  
AND DUMPERS, ETC.



**KIRKSTALL FORGE ENGINEERING  
LIMITED** LEEDS, 5

Telephone: Horsforth 2821

*Build quality into  
your engines  
with*



**RENOLD**

**TIMING CHAINS**



*—the FIRST name in precision chain*

RENOLD CHAINS LIMITED MANCHESTER



# OAKENSTRONG OAKENCORK OIL and PETROL GASKET MATERIALS

DISTRIBUTORS OF MATERIAL IN BULK  
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OAKENCLOUGH, GARSTANG  
Nr. PRESTON, LANCS.  
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The Autocar A.P. 40 mining truck, built by the Autocar Division of the White Motor Company, has the Fuller R-1550 ROADRANGER Transmission.

## THE FULLER R-1550 ROADRANGER TRANSMISSION

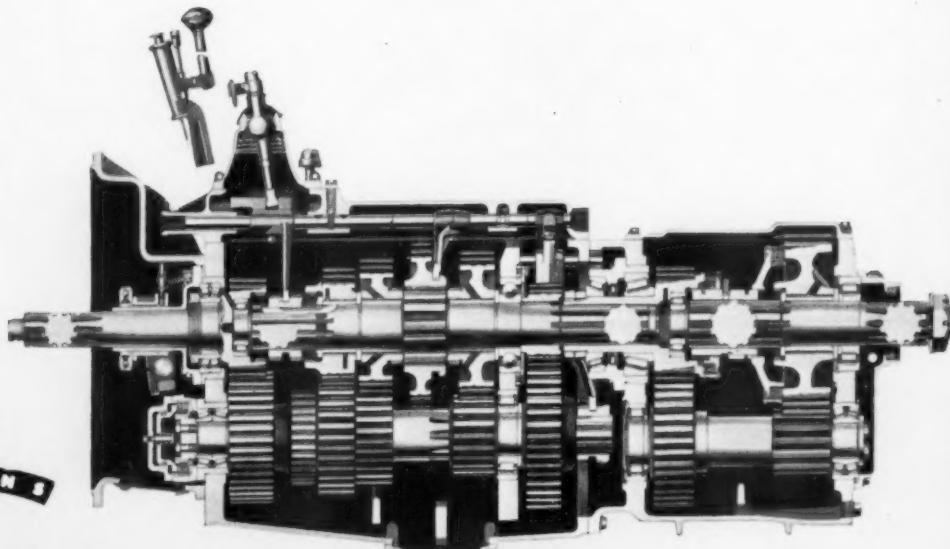
This 9-speed semi-automatic transmission is designed primarily for extremely heavy duties off the highway and for severe industrial applications requiring maximum torque capacity such as may be imposed by 1550 cu. in. diesel engines developing up to 600 h.p.

Ratios are well spaced by steps averaging 38%, with direct drive in 8th and a .69 overdrive ratio in 9th speed. Reverse speed ratios are 9.56 and 2.71.

The range selector is mounted on the gear shift lever and operates the air selector valve which controls the range-shift air-powered cylinder.

A further feature which assists in making clean changes is the pre-selective air-powered countershaft inertia brake to check spin-on during upward shifts. The location of the pre-selector valve is to customer's choice.

Other features include S.A.E. standard heavy-duty and regular-duty type Power Take-Off openings as well as a special trough and sump arranged to trap and hold foreign material.



**Fuller**  
TRANSMISSIONS

Exclusive European Representatives for the  
Fuller Manufacturing Company of Kalamazoo, Michigan, U.S.A.  
AUTOMOTIVE PRODUCTS COMPANY LTD.

Brock House, Langham Street, London, W.1, England  
Telephone: Langham 2527

# RADIATORS



cool efficiency behind  
the hottest styling

CMF give a design and manufacturing service, which has been confidently and confidentially used by automobile engineers for more than fifty years



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CO. LTD.

COVENTRY ENGLAND Tel. 3144-5-6

Cogem

# MIDCYL RESEARCH

helps smooth out problems



*it is the continued research of Midcyl that helps smooth the way of the Auto Engineer with such of his problems as are associated with Cylinder Blocks, Cylinder Heads, Camshafts and Brake Drums*



THE MIDLAND MOTOR CYLINDER CO. LTD., SMETHWICK, STAFFS

*Something  
New!*

**CEJ**  
**"HI-TEN"**  
**TAPS**

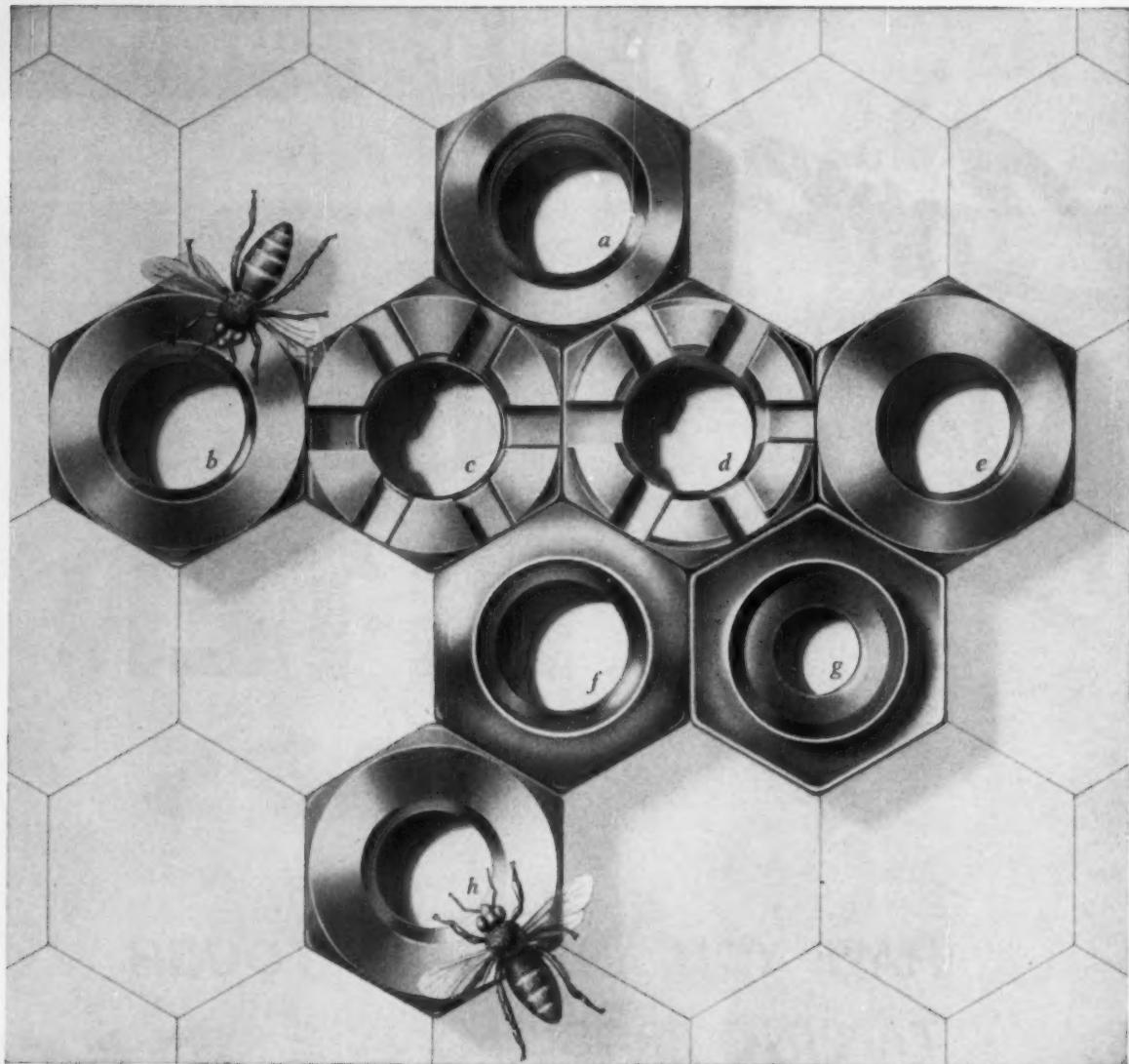
**HAVE YOU ANY REALLY TOUGH  
TAPPING PROBLEMS  
IN HIGH TENSILE STEELS ?**

A NEW MANUFACTURING PROCESS IS GIVING  
AMAZING RESULTS AND MUCH LONGER TAP LIFE  
ON THESE DIFFICULT MATERIALS

★ Tell C.E.J. about your problems and they  
will find the answer

**C.E.JOHANSSON LTD.**

SOUTHFIELDS ROAD · DUNSTABLE, BEDS.



## SIMMONDS MAKE NUTS FOR BUSY PEOPLE

Simmonds, the self-locking nut specialists, also make standard nuts faster than you can use them—bar turned and cold formed, in a wide range of sizes, steels and finishes. There are so many you can always get *exactly* the nut you want. If you need a special nut or turned part for a special job you can get that too. Just contact Simmonds.

- a* Cold formed double chamfered steel nuts
- b* Full nuts
- c* Slotted nuts
- d* Round top castle nuts
- e* Thin lock nuts
- f* Special nuts
- g* Root nuts
- h* Special cold formed nuts

## SIMMONDS AEROCESSORIES LIMITED TREFOREST, PONTYPRIDD, GLAMORGAN

Branches: London, Birmingham, Manchester, Glasgow, Stockholm, Copenhagen, Ballarat, Sydney, Johannesburg, Amsterdam, Milan and New York



A MEMBER OF THE FIRTH CLEVELAND GROUP

7036N

# THIS IS NEW!

## 100% ACCURACY AND FINISH

- ★ **Adaptability**
- ★ **Low Capital Outlay**
- ★ **Space Saving**
- ★ **Integral Cam Feed**
- ★ **Super Precision Bearings**

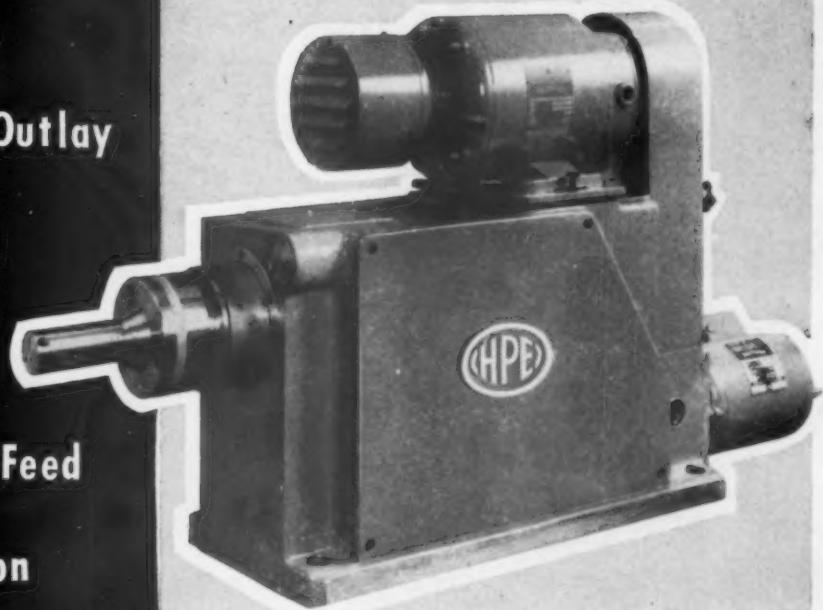
Manufactured by :—

## High Precision Equipment Ltd

DESIGNERS AND MANUFACTURERS OF SPECIAL MACHINE TOOLS

**BLETCHLEY BUCKS**

Phone: BLETCHLEY 3403/4/5

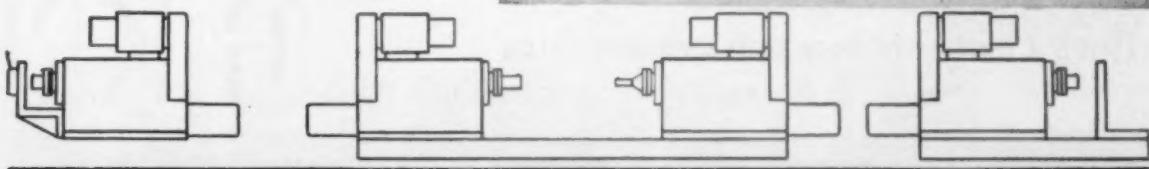


The FB4F Fine Boring Unit Head illustrated above incorporates an independent feed motion, transmitted to its spindle quill through a simple plate cam, which can be designed to give a fast approach and varying rates of feed. The robust spindle and quill, together with super precision spindle bearings, ensure a high degree of finish and roundness.

These self contained units are readily adaptable for a wide variety of applications without need for costly set ups.

Particularly suitable for mounting on simple base plates together with the necessary work holding fixture enabling single purpose units to be constructed for the minimum of time and cost. Wide range of speeds and feeds obtainable by changing feed cam and motor pulley.

"Descriptive brochure on request."

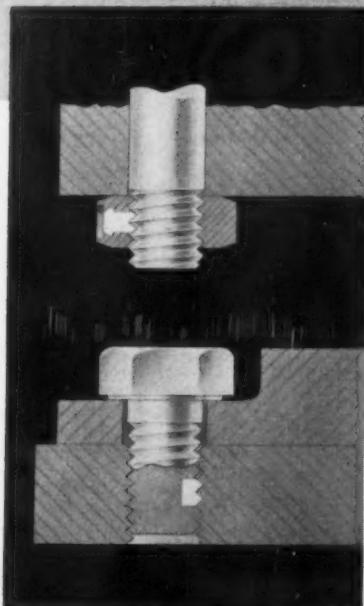
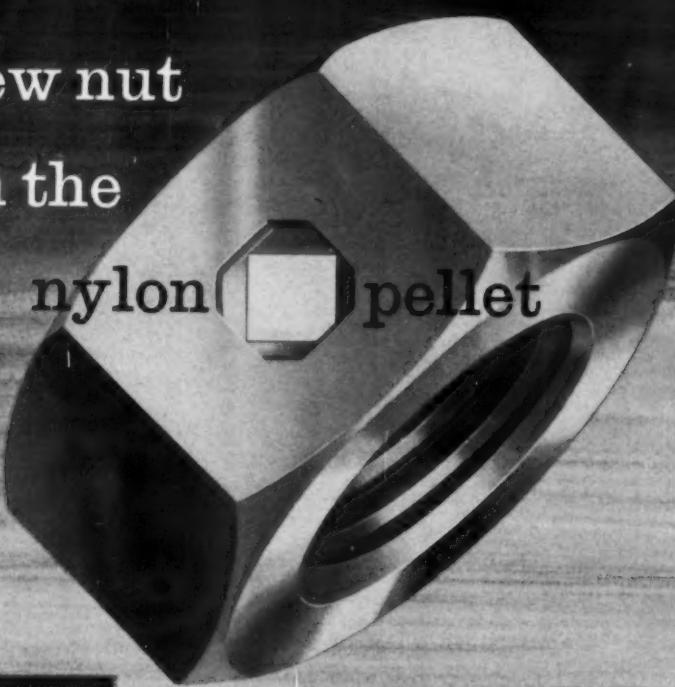


# W E D G L O K

the new nut

with the

nylon  pellet



Wedglok nuts are completely self-locking. They will not work loose through vibration or reversal of stress. They need no locking devices—and the locking-action is unaffected by age or temperatures within the normal range.

#### How is it done?

In a Wedglok nut the locking element consists of a tough, resilient nylon pellet. This is inserted in the body of the nut and projects slightly above the crest of the thread. When the nut is turned the pellet sets up a wedging action, gripping the threads tightly. This counter-thrust creates metal to metal engagement of mating threads. The Wedglok principle can be applied to screws as well.

If it's a matter of how to fasten one thing  
to another . . . get in touch with

**G K N**

*Wedglok Self-Locking Products are manufactured under licence in the United Kingdom solely by  
Guest Keen & Nettlefolds (Midlands) Ltd., Screw Division, Box 24, Heath St., Birmingham 18. Tel: Smethwick 1441  
2/xx/3835*

# DAMPING

## TORSIONAL

## VIBRATION

### Leaders in design

The two greatest advances in smoothing the present-day high-performance engine are the rubber torsional vibration damper and 'floating power' engine mountings. Both were developed by Metalastik.

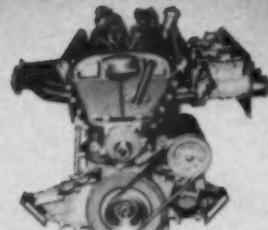
Metalastik torsional vibration dampers, with their instant response to vibrations of even the slightest amplitude, need no description; their effectiveness is widely known.

Extensive experience with so many different types of engine, coupled with modern test equipment, makes it possible for us to predict accurately the performance of Metalastik torsional vibration dampers. Moreover, by our design methods a damper can be designed so as to transfer critical frequencies to other and less critical ranges.

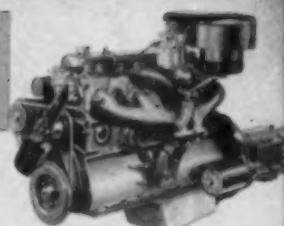
Lastly, Metalastik T.V. Dampers permit a great range of r.p.m. without detriment to the engine.

It is this unique combination of advantages that has made the Metalastik torsional vibration damper such a widespread success.

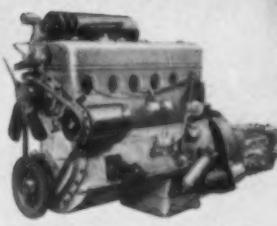
The small illustrations show some famous petrol engines with Metalastik T.V. Dampers. Equally successful on diesel engines, many world-known oil-engine manufacturers fit Metalastik dampers.



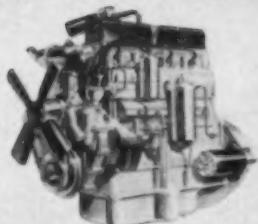
David Brown  
Aston Martin 3-litre engine



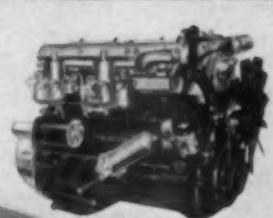
B.M.C. 'C' series engine



Daimler D.K. 400 engine



Humber Hawk 2267 c.c. engine



Jaguar 3.4-litre engine

# METALASTIK

METALASTIK LTD., LEICESTER

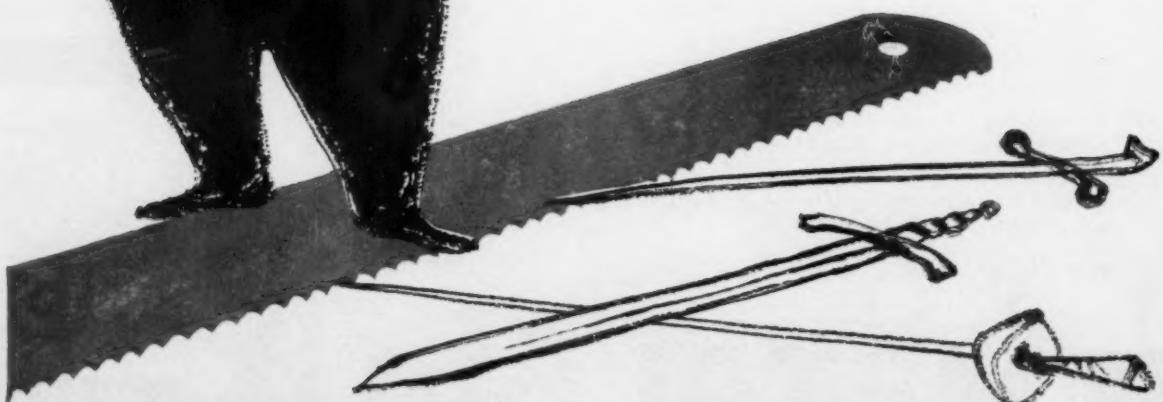


USE

Eclipse

HACKSAW BLADES

*and  
feel  
the  
difference!*



'Eclipse' hacksaw blades and other tools are made by James Neill & Co. (Sheffield) Ltd. and are obtainable from all tool distributors

UH 26

Sand Casting  
in Hiduminium for  
Armstrong Siddeley Motors Ltd.

For all  
sand castings

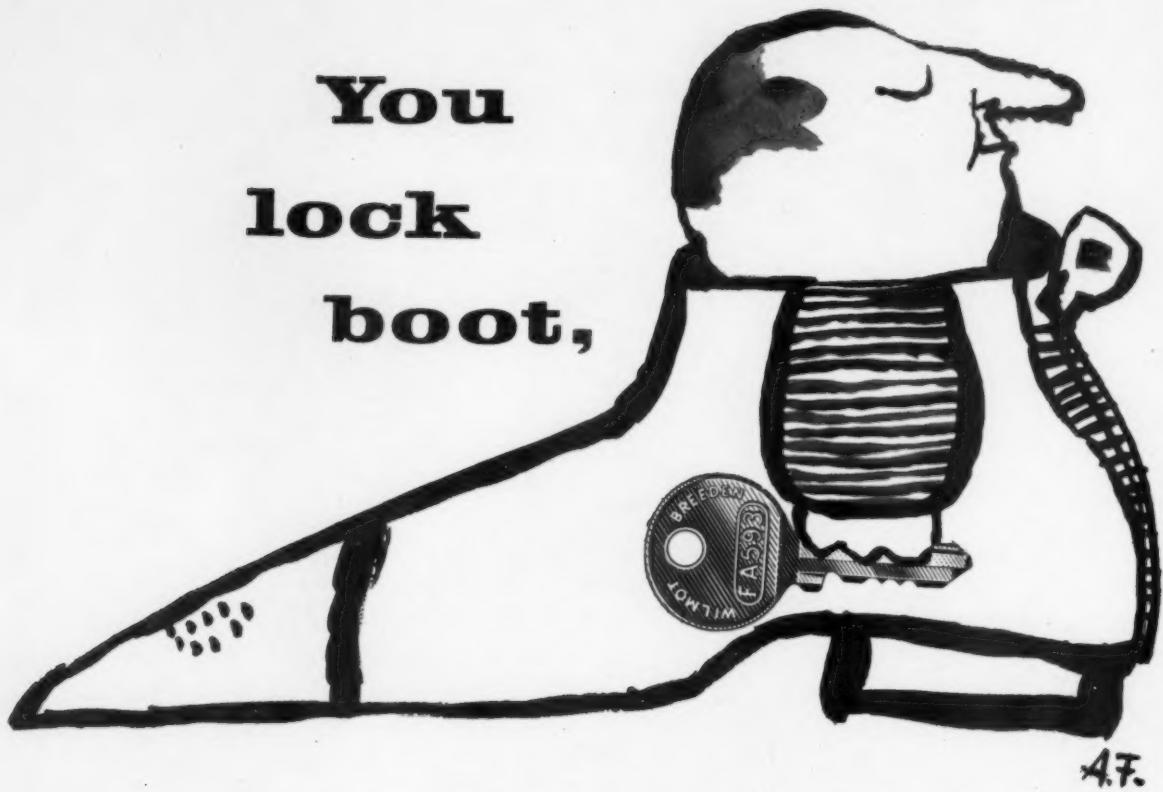
experience has shown . . .

**Hiduminium** **Aluminium**

MAKES THE MOST OF

**HIGH  
DUTY  
ALLOYS** LIMITED SLOUGH BUCKS

You  
lock  
boot,



hop into driving seat, self-starter, goodbye wife,  
and off. All well.

*What if boot wouldn't lock properly? All not well.  
Niggling doubt. Somebody pinch golf clubs...*

*Blasted boot can't trust with golf bag? What use car with boot  
like that? Liability. Get rid of. Discard. Do without. Walk.  
Healthy? Bus queues. Drizzle. Miss appointments.  
Lose hope. Lose wife. All up.*

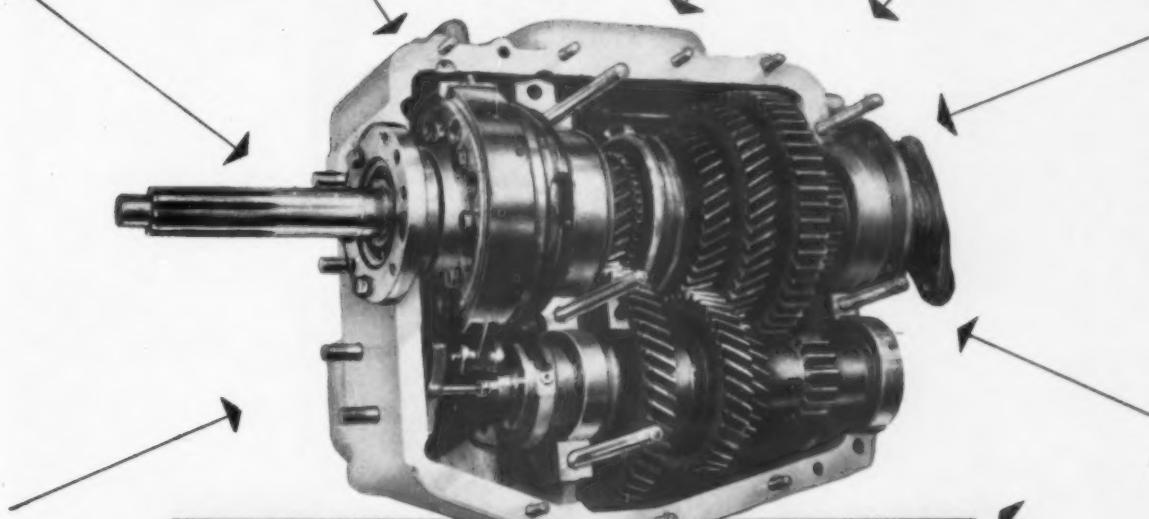
Ah! but Wilmot Breeden made boot-lock! Made boot lock.  
Sound design, infinite patience, metallurgy,  
research, brutal testing, photo-micro-scrutineering.  
Safe now. For ever.

Not only boot-lock. Door locks, door handles, window-winders,  
bumpers rear, bumpers fore, ignition key, steering wheel, likely.  
*Virtually every British car roads today carries some components*  
*Wilmot Breeden. Reason why. Hurray.*

**WILMOT BREEDEN** are at Birmingham: also at London, Manchester, Bridgwater, Glasgow, Melbourne, Toronto.

**FEATURING**

THE NEW  
**Moss Gear Box**



**NOW AVAILABLE FOR  
6 OR 8 SPEED**

Inclusive of Overdrive

Incorporating fingertip control  
for double speed changing  
without declutching

**MOSS  
GEARS**

**THE MOSS GEAR CO. LTD.  
CROWN WORKS, TYBURN, BIRMINGHAM, 24**

Telephone : ERDington 1661/6

Telegrams : 'Mosear, Birmingham.'

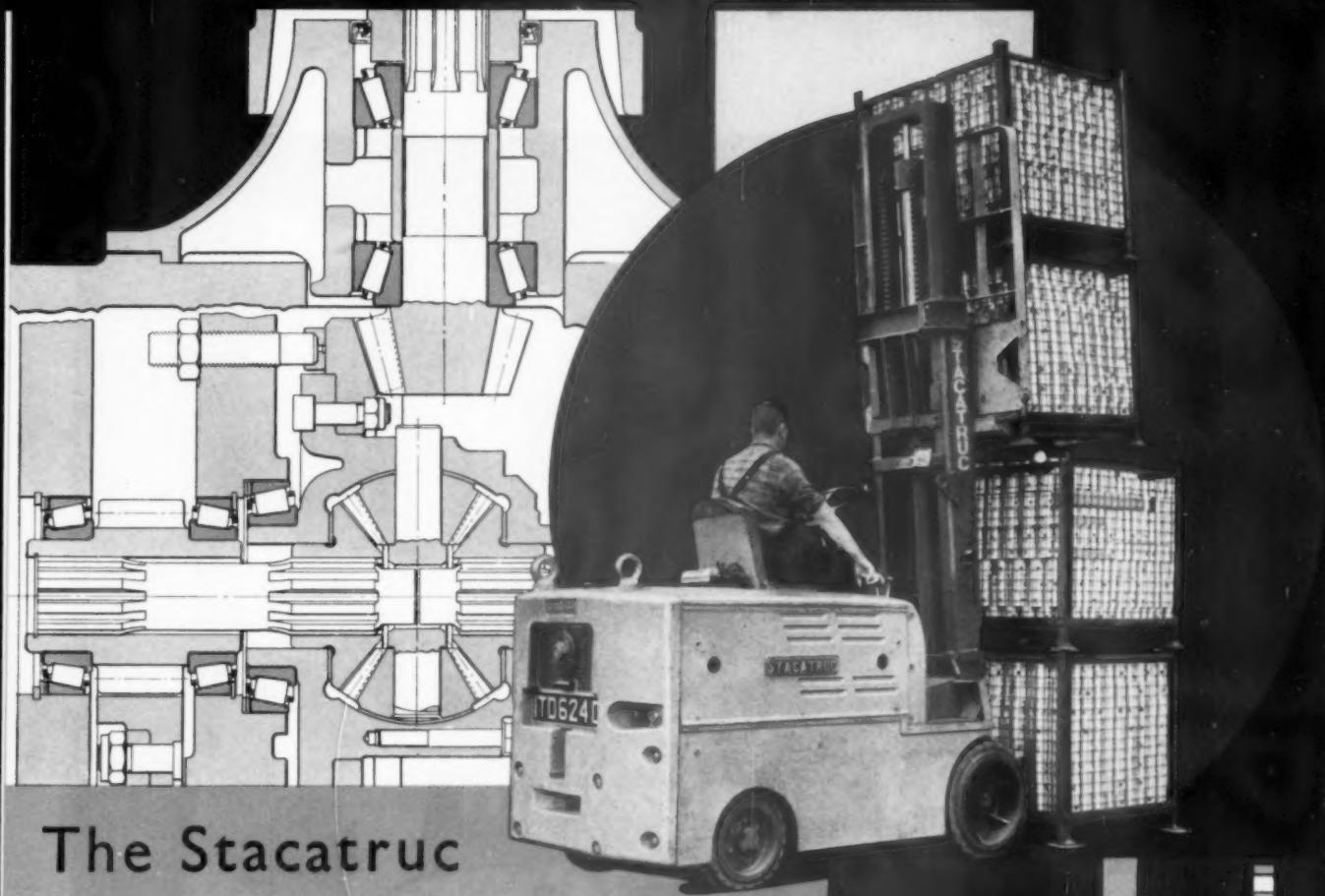


Whatever route your drivers travel, they can refuel with Shell Derv at the nation-wide network of Shell Derv agencies. At these agencies your drivers can, by showing a Shell Authority Card, refuel on a pre-arranged credit system, or they can pay cash. Ask your local office of Shell-Mex and BP Ltd. for full details of this scheme.

## SHELL MEETS THE DEMAND FOR DERV ALL OVER BRITAIN



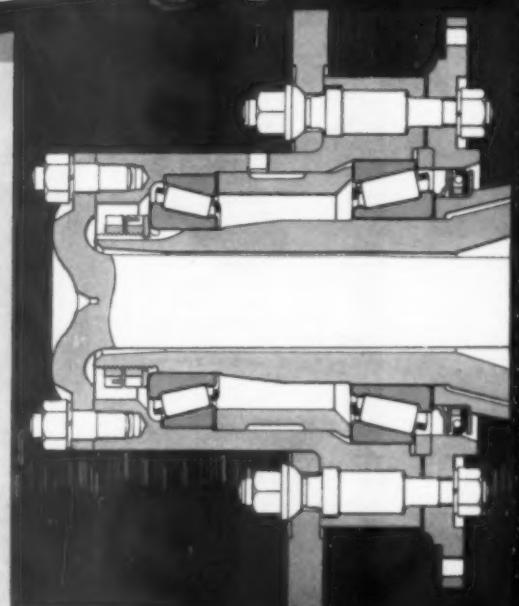
YOU CAN BE SURE OF SHELL



## The Stacatruc

Made by I.T.D. Ltd. of Birmingham, the Stacatruc 624D is widely used in industry.

The sectional drawings of the transmission and wheel bearings show the practice followed, with heavy-type differential gear and full-floating driving shafts to hubs carried direct on the axle casing. The drawings show the arrangement of the Timken bearings.



# TIMKEN

Regd.  
Trade  
Mark

*tapered-roller bearings*

**MADE IN ENGLAND BY  
BRITISH TIMKEN LIMITED**

DUSTON, NORTHAMPTON (Head Office) and DAVENTRY, NORTHANTS

Telephone: Northampton 4921-8 and 3452-3. Telex No. 31-620

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SUBSIDIARY COMPANIES: FISCHER BEARINGS COMPANY LTD., WOLVERHAMPTON  
TIMKEN-FISCHER STOCKISTS LTD., BIRMINGHAM

a good  
vehicle  
starts with

## AC-Delco QUALITY PRODUCTS

Virtually every British vehicle has one or more AC-Delco products designed into it at drawing board stage. AC-Delco research engineers will gladly help when you are planning a new design or modifying an existing one.

DELCO-REMY  
Oil-Filled Coils

AC Instruments

DELCO-REMY Switches

DELCO Electric  
Screen Wipers

These are a few of the many AC-Delco remarkable and efficient products.

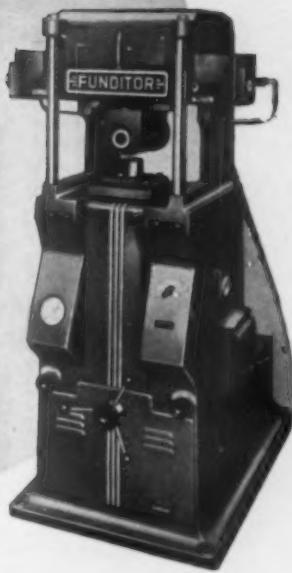
Write to: Delco-Motors, 4000 North Michigan Avenue, Chicago 11, Illinois.

AC-Delco DIVISION OF GENERAL MOTORS LIMITED, DUNSTABLE, BEDFORDSHIRE, ENGLAND  
Manufacturers of electrical and motor products. Telephone: DUNstable 48491

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for the world's  
**MARKets!**



The Sand-Jet Marking Machine (illustrated above) permanently marks carbide, stainless steel, ceramics, glass and delicate thin-walled articles which cannot be marked by normal methods.

Your mark on your products must be distinctive and permanent. The modern method is to mark all parts with numbers, symbols or letters for easy and speedy reference. FUNDITOR marking machines will do this as well as mark your goods with your brand name—a permanent advertisement to sell constantly for you. Manufacturers in all trades are using the FUNDITOR Marking Method—which is speedy and efficient for the permanent marking of metal, plastic, ceramic, glass and wood components.

## **FUNDITOR MARKING MACHINES**

From hand-operated machines to powerful heavy-duty machines—there's a FUNDITOR machine to solve your marking problem. Send us a sample part for delicate or deep marking to your specification.

Send to-day for our latest catalogue showing over 100 illustrations.

**FUNDITOR LTD., 3 WOODBRIDGE ST., LONDON, E.C.1**

Telephone: CLErkenwell 6155-7

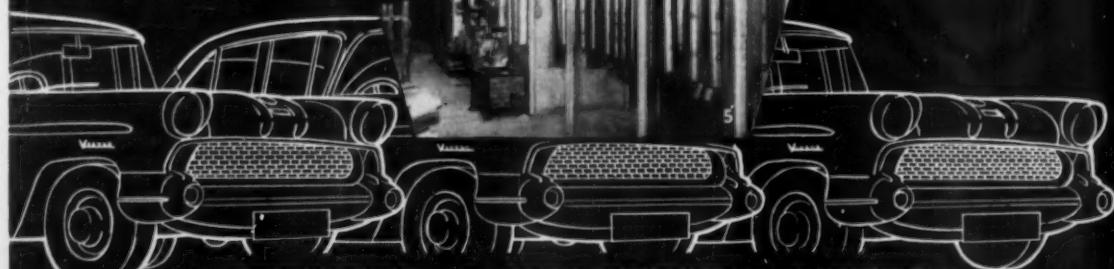
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at Vauxhall

Mass production methods require efficient and reliable plant. We are proud that Vauxhall Engineers selected Centriblast equipment for the new Car production building.

- 1 Rotary Table Cleaning half shafts.
- 2 Centriblast Automat for descaling inlet and exhaust valves.
- 3 Compressed Air Table Machine for gear cases.
- 4 8ft. Multi-table Machine descaling gears.
- 5 Continuous Blast Cleaning of Silencers at Dunstable factory.



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COOPERS engineers  
are available for  
consultation at all  
times.

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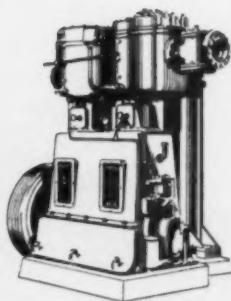
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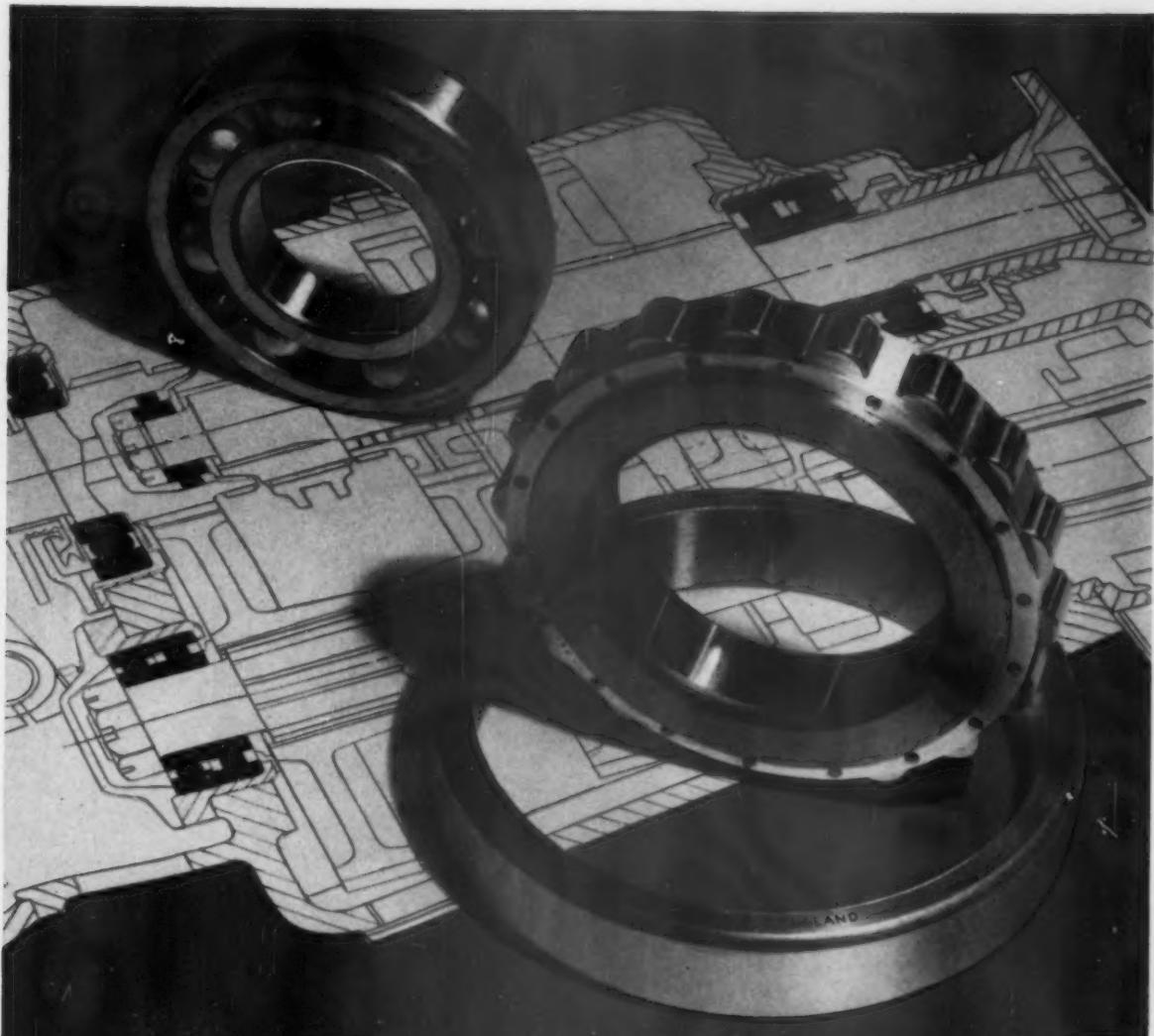
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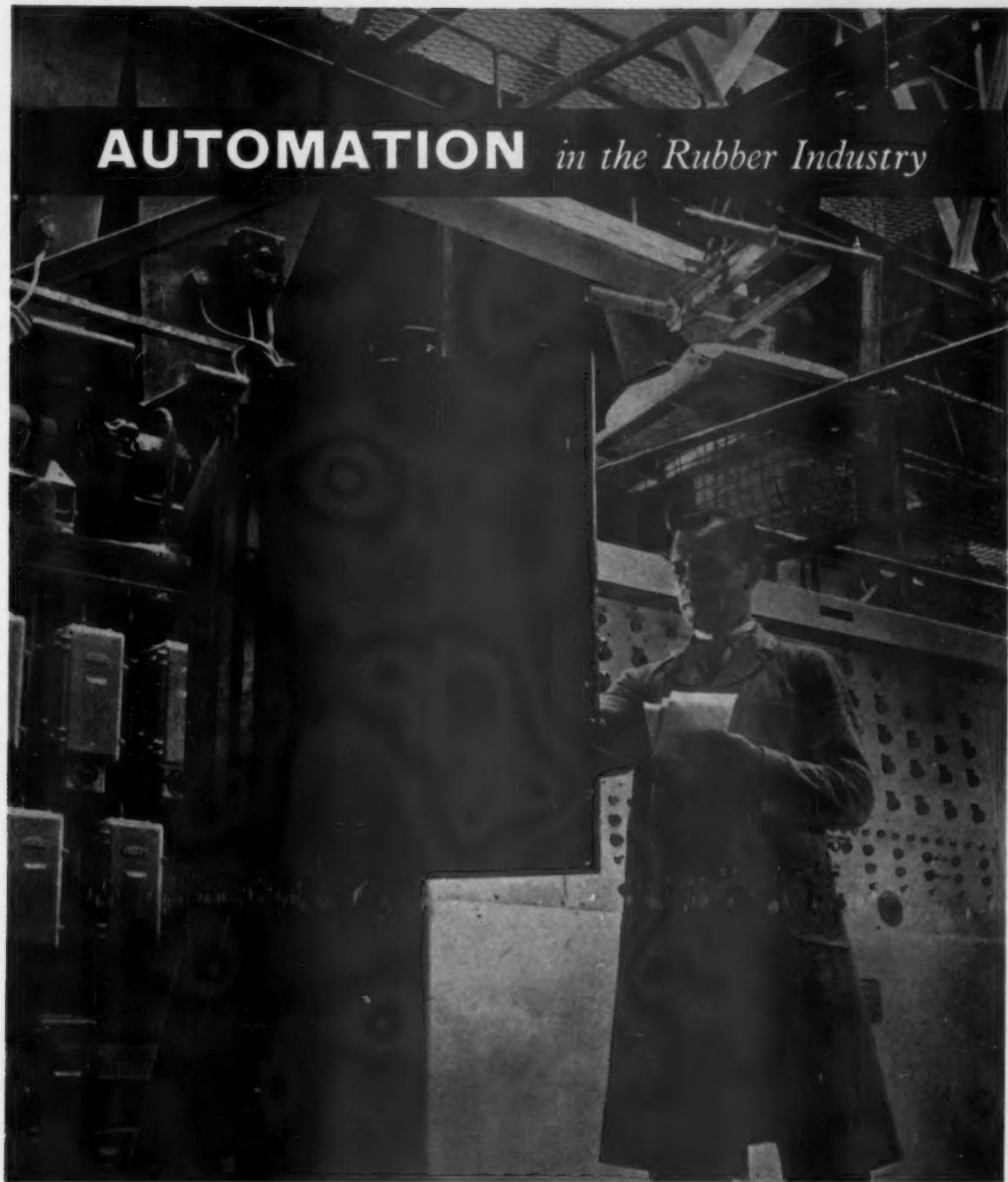
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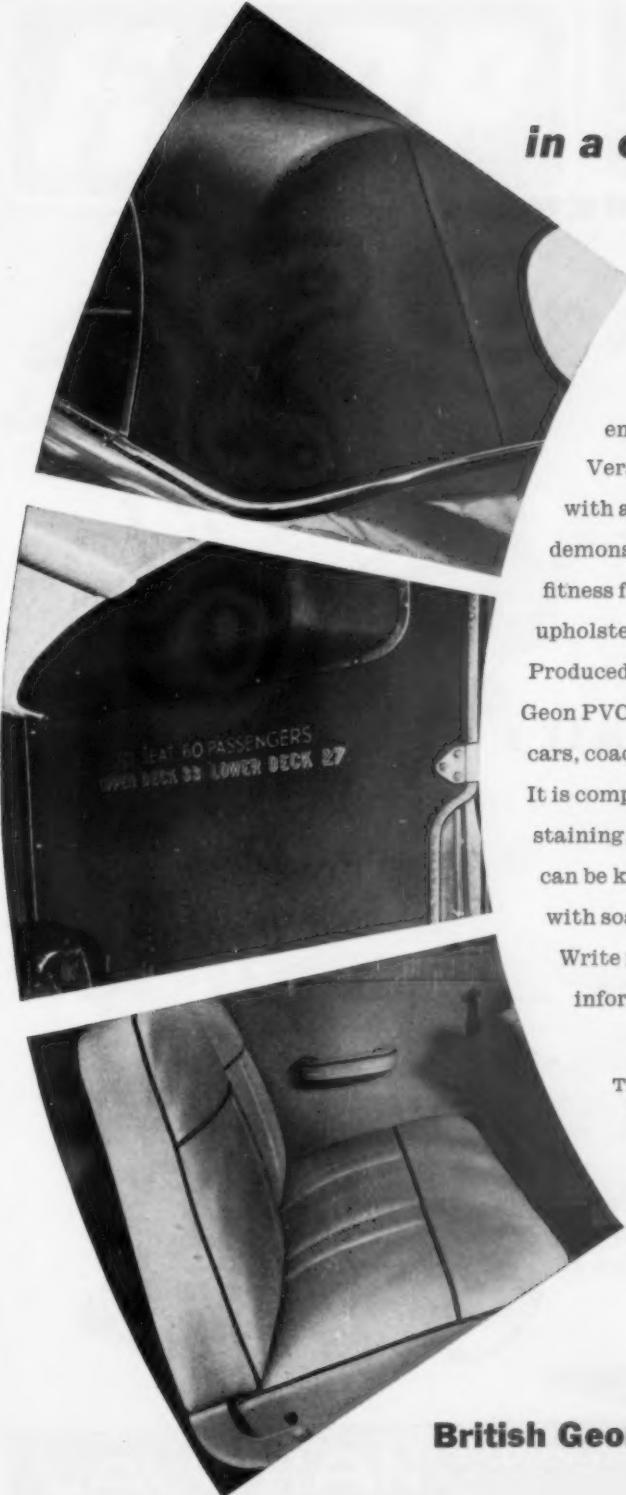
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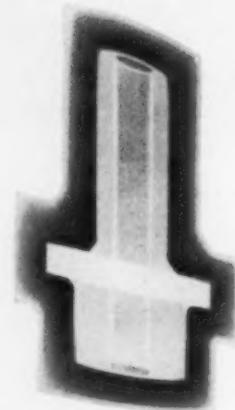
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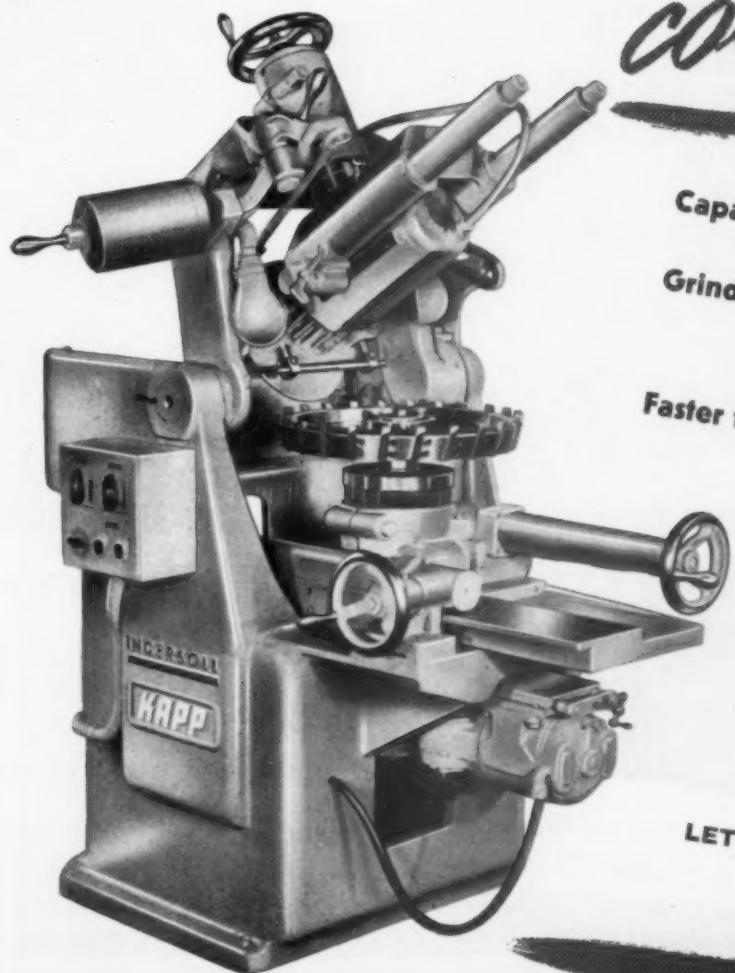


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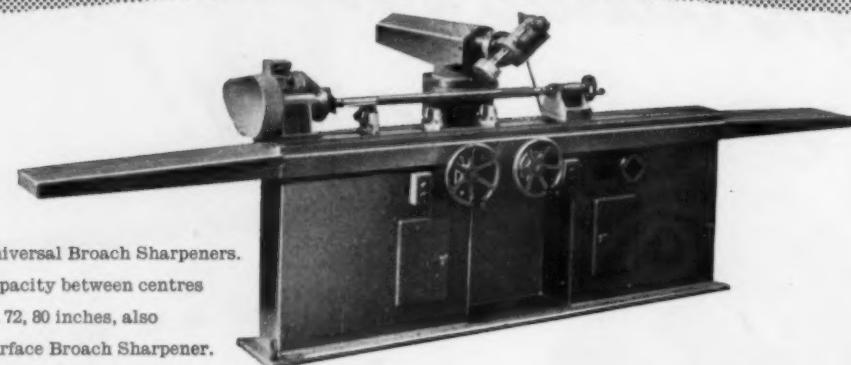
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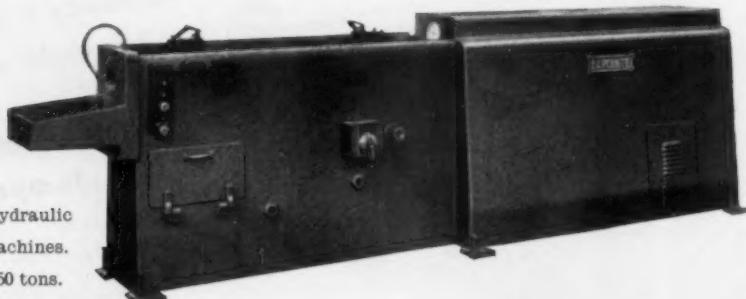
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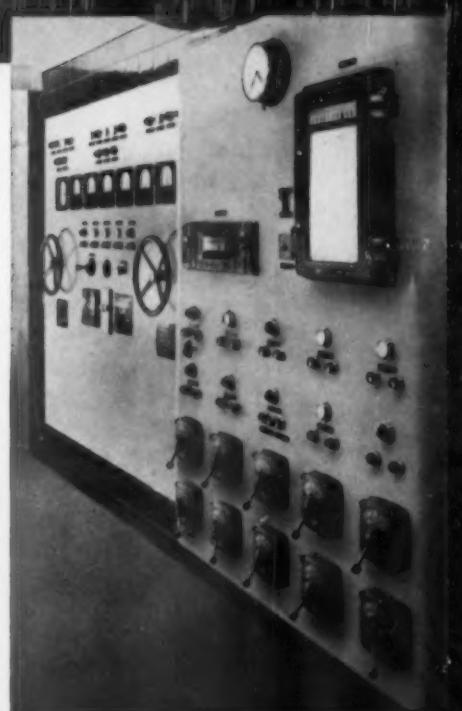


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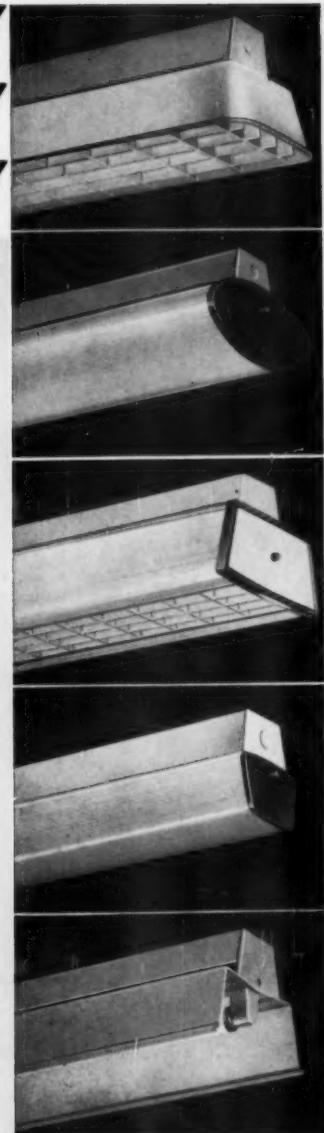
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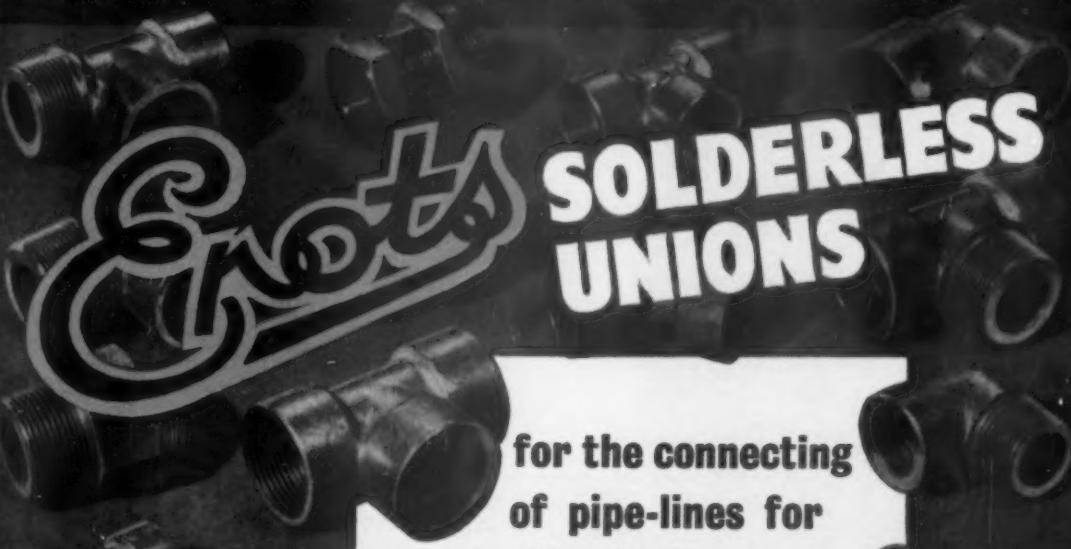
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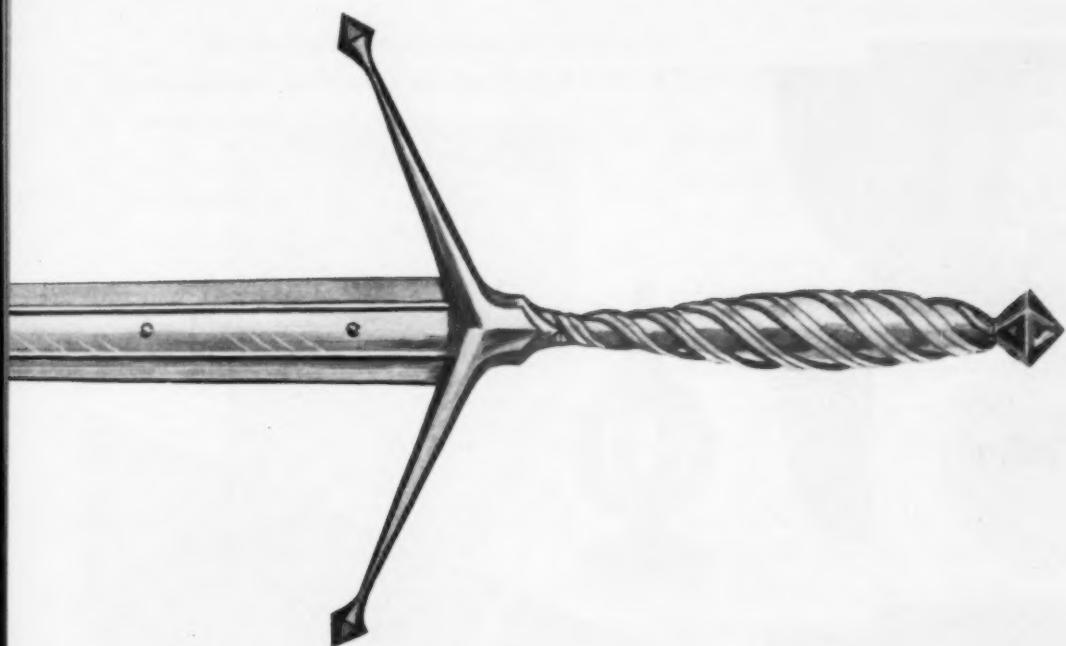


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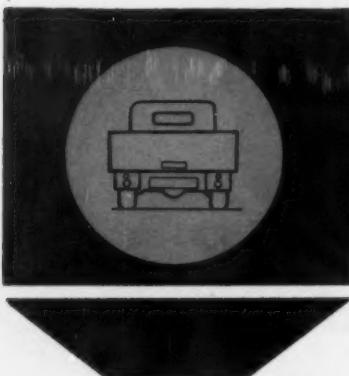
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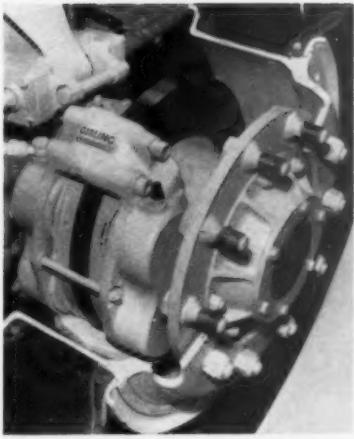
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# AUTOMOBILE ENGINEER

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## *The Conquest of Friction*

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DESIGN MATERIALS **AUTOMOBILE**  
**ENGINEER** PRODUCTION METHODS WORKS EQUIPMENT

## Commercial Vehicle Progress

WITH the promise of improved roads in this country, the trend towards the employment of engines of higher power output, which has already been apparent for a year or so, has received added stimulus. From every point of view this trend is welcome. It will make our commercial vehicles even more acceptable for operation in foreign countries; at home, economies in maintenance will be obtained as a result of engines being less heavily loaded, and probably there will be less temptation for drivers to tamper with fuel injection systems to obtain better performance.

So far, two methods have been used for increasing the power output of existing engines. One is the employment of thinner cylinder liners so that the bore is correspondingly increased, while the other is the installation of a turbocharger. Thin liners undoubtedly are attractive from many points of view and, if their bores are chromium plated, exceptionally good results are obtained so far as wear resistance is concerned. However, this type has not yet been developed to the stage where it can be used as a wet liner. The main problems are vibration and deflection under load, which are liable to cause cavitation erosion of the outer periphery and piston ring blow-by; there are also problems with regard to the fixing of such thin liners in the block. For corrosion prevention of liners in general, a promising line for further development is the ceramic coating of wet liners. Although ceramic materials are not good conductors of heat, the coating need not be so thick as to make any appreciable difference to the heat flow.

If turbocharging is employed, considerable gains can be obtained not only in power output but also in respect of fuel consumption. Another advantage of the turbocharger is that provided it is properly matched to the engine there is less tendency to exhaust smoke; also thermal efficiency is improved. Despite the fact that the installation of a turbocharger is more expensive than the incorporation of thin liners and that a turbocharger is not always easily accommodated in the limited space available, the project is worthy of careful consideration.

In view of the fact that operating conditions vary widely as between different countries and even between different areas in this country, manufacturers might give more consideration to offering alternative transmission arrangements, possibly using proprietary units. For example, for public service vehicles operated in the Low Countries, a simple automatic transmission comprising a torque converter coupled with a two-speed gearbox is not

merely adequate, but is even more suitable than a conventional gearbox.

With regard to final drive units, it would appear that there is scope for considerable rationalization throughout the industry, particularly in view of the moderate quantities produced by each manufacturer. In some instances individual firms manufacture several different types of axle, apparently without adequate justification. The resultant multiplicity of designs, spare parts and production and tooling problems can hardly be desirable from the point of view of economics.

Although air suspension systems have been under consideration for several years, many manufacturers still remain to be convinced that they are suitable to replace the conventional systems already in use. It would appear that more thought should be given to the alternative, a mechanical spring system having an approximately constant rate under varying load conditions and incorporating a self-levelling device. Possibly a combination of steel and rubber springs could be devised to obtain the required characteristics. In this connection it should be borne in mind that the laminated steel spring not only locates the axle but also absorbs shocks in the longitudinal and lateral as well as the vertical planes; this type of spring, therefore, has much to commend it.

There is still room for improvement in connection with ease of entry to cabs and to public service vehicles. Some noteworthy advances in this aspect of design were apparent among the exhibits at the commercial vehicle show this year and, undoubtedly, this trend will continue because of its value as a selling feature. It is most important that the body entrances should be given full consideration when the vehicle frame is designed. In many instances it is desirable to lower the frame locally so that the entrance can be at the most convenient height.

Perhaps it is not too much to hope that taxation reliefs will follow the recent changes in legal requirements and the improvements to our roads. Not only would this enable our industrial system to function more economically so far as the employment of its capital equipment is concerned, but also it will give manufacturers more scope for improving their designs. At present this scope is, of course, limited by the fact that any improvement that increases the basic cost of the vehicle also adds to the amount that the customer has to pay in tax. This is a penalty that customers will not willingly pay, so improvement is to some extent discouraged by current taxation.

# COMMERCIAL VEHICLE EXHIBITION

## *Engines*

*Quest for Increased Power Continues; More Interest in  
Turbochargers and Distributor Type Fuel Injection Pumps*

AS was the case two years ago, no revolutionary engine developments have appeared at the 1958 Commercial Motor Show. Nevertheless, considerable progress is obviously being made in several directions, and the next year or two should see a speeding-up in the progressive trends already apparent. With the prospect of higher-speed road transport consequent on the development of motorways, the emphasis has shifted from the smaller to the larger power units, for which reason there is little to report on petrol engines.

Activities in the diesel engine field are being largely directed towards improving power outputs without corresponding increases in overall dimensions, and with the minimum of additional weight. Within this framework there are two means of attaining the desired results. They are increasing the cylinder bore, and supercharging. A larger bore may be accommodated merely by modifying the cooling system to cope with the reduced water space between the cylinders, or it can be effected by the use of different cylinder liners. A wet liner can reasonably be expected to take up less space than an orthodox dry liner but there is the interesting alternative of the thin-wall steel liner with chromium plated bore, introduced by Laystall Engineering Co. Ltd. and fitted

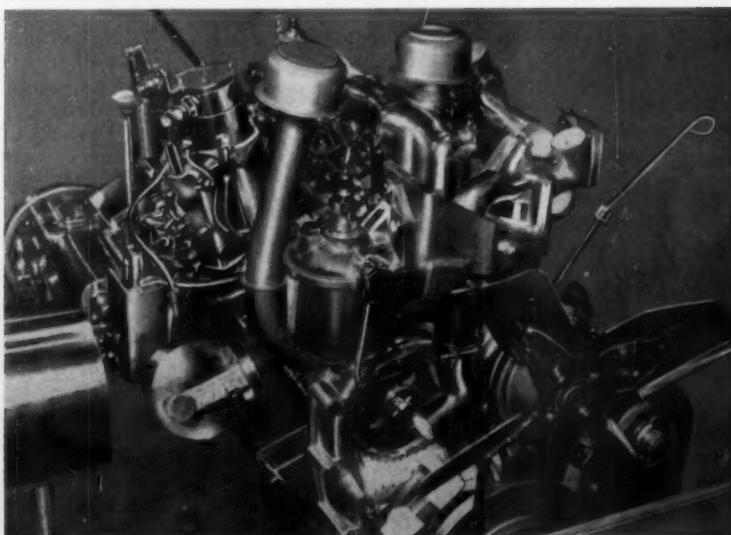
to a Perkins engine described later. The walls of this liner are only 0.040 in thick.

The plated thin-wall liner gives maximum utilization of space within the cylinder block, is lighter and cheaper than the cast iron type and has an extremely long life potential. Also, provided the thermal contact with the block is satisfactory, it should give a better path for heat flow to the coolant. Although certain other liner manufacturers are experimenting on similar lines, no other examples are so far in production. Arguments advanced against the type are that, if the interference fit is heavy enough for security when the engine is cold, there is a risk of buckling under extreme operating conditions, with consequent risk of piston ring blow-by. Again, any separation of liner from block could give rise to fretting corrosion, and if oil should seep between the two surfaces, its breakdown there could make it impossible for normal contact to be restored.

Corrosion, including cavitation corrosion, of wet liners is another problem, particularly if the liners are of relatively thin section and so liable to flexure and vibration. Tests with sprayed-on aluminium coatings have not been entirely satisfactory, but good results have attended experiments

by Wellworthy Ltd. with a thin Al-Fin bonded aluminium coating. With hardened liners, however, the tempering temperature is close to that of the Al-Fin process.

In connection with corrosion prevention, another promising avenue for exploration is the ceramic coating of wet liners. After considerable experimental work, liners with a coating of this type have been put into service by A.E.C. Ltd. on two of their existing engines, and are specified on two new units. Although ceramic



*On the Land-Rover diesel engine, the C.A.V. distributor type fuel pump is driven by a spiral gear, in much the same way as an ignition distributor*

materials are not good conductors of heat, the coating is too thin to make any appreciable difference to the rate of heat flow to the coolant.

Supercharging, the other method of increasing output from a given size of engine, is being assiduously followed up by a number of engine manufacturers. As would be expected, interest has been centred on the turbocharger because of its light weight, compactness and the fact that it needs no positive drive from the engine. Moreover, it largely matches its output to the operating conditions: under light load the energy of the exhaust gas is small and so the speed of the turbine is low; as the load increases, so the gas energy increases and the blower speeds up.

One of the features of the exhibition was the number of turbocharged engines displayed. No fewer than five makes of turbocharger are now offered—B.S.A., Holset-Schwitzer, Rotol, Simms-Eberspächer and Cummins. Of the five, only the B.S.A. is completely indigenous.

Two operational disadvantages have revealed themselves on some turbocharged engines. First of these is that inertia tends to prevent the turbine-impeller unit from speeding up instantaneously when the engine is put under load. There is thus a lag in the air supply, and smoking is liable to occur until the turbine catches up. In this respect the B.S.A. unit shows up well because of the relatively low inertia of its rotating parts.

The second difficulty is that if the turbocharger is arranged to give the desired boost at the engine speed at which maximum b.h.p. is developed, the peak torque occurs higher up the speed range than in the case of a normally aspirated version of the same engine. This is because of the falling-off in air delivery with reduced engine speed. To improve low-speed pulling without over-boosting at high speeds, an ingenious control system has been introduced by Rotol Ltd. and is fitted to the Rolls-Royce engines used in certain Caterpillar equipment, though it has yet to appear on a road vehicle.

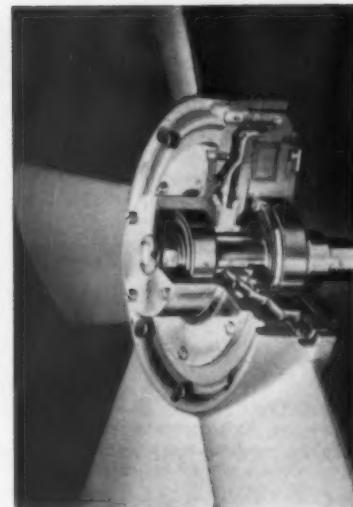
Known as the waste-gate system, this method of control consists basically of an automatically operated by-pass valve in the exhaust system upstream of the turbocharger. When the valve is open, some of the exhaust gas is diverted from the turbine, the speed and air delivery of which are consequently reduced. The valve is controlled by a pressure-sensitive device in the induction system and the setting is such that the permitted boost cannot be exceeded at maximum governed speed and full load.

By virtue of this control, the turbocharger characteristics can be such that initial acceleration of the rotor unit is considerably more rapid, giving reduction of smoking, and the full air requirement is delivered at a lower blower speed. Thus, peak torque is restored to its normally aspirated level in the speed range. While the Rotol system increases the complexity and cost of the turbocharger installation, it does enhance its efficiency and so should be attractive for use in heavy commercial vehicles.

Undoubtedly, the turbocharger will carve an increasingly large niche for itself in the diesel engine sphere, not only in this country but on the Continent, where experimental work with pressure ratios of over 2 : 1 is already being carried out. So far, there has been no production application to two-stroke engines, but the possibilities are considerable.

The popularity of the open combustion chamber for the larger type of diesel engine continues to be evident in the new units. Although the toroidal piston-crown cavity is the most popular form, L. Gardner & Sons Ltd., in the highly efficient 10.45 litre addition to their range, remain faithful to the concave, hemispherical crown. The swirl chamber layout, generally considered to be more suitable for the smaller high-speed engine, is utilized, however, by F. Perkins Ltd. on two new engines of over 3 litres, which admittedly are derivatives of existing designs. It also

Smiths' magnetic particle fan coupling sectioned for exhibition purposes. This coupling is thermostatically controlled



appears in somewhat modified form on the same company's latest small unit, of 1.621 litres.

The C.A.V. distributor-type fuel pump is now fitted to a number of the smaller diesels, both four-cylinder and six-cylinder. This is understandable because it offers advantages in bulk, weight and cost over the corresponding in-line equipment and these factors are particularly important in the smaller engine designs. The distributor pump has the additional advantage of being fundamentally more suitable than the in-line pump for high-speed operation, owing to its small reciprocating inertia. Also, the virtual absence of reverse loading results in low driving torque, evidenced on the Land-Rover by its skew-gear drive from the camshaft, in exactly the same way as for an ignition distributor. The makers claim that their metering valves give the pump a performance directly comparable with that of an in-line pump and evidence of their faith in the product is the large new plant laid down for its manufacture.

Any reduction in power loss within the engine installation clearly results in either increased performance or improved economy of operation. Higher mechanical efficiency has been sought in the Gardner engine, already mentioned, by reducing the number of piston rings. In having two compression rings and one scraper, the pistons now conform to what is normal car and motor-cycle practice. It remains to be seen whether blow-by and oil consumption can be effectively controlled over large mileages with the smaller number of rings.

The cooling fan is a notorious power waster. On the basis that the power absorption is proportional to the square of the rotational speed, Gardner fit a large fan which is not geared up, but runs at engine speed. They claim that it only requires 2.8 b.h.p. at 1,700 r.p.m.—an unusually low figure. Higher fan efficiency is sought by Leyland Motors Ltd. through the means of tapered aluminium blades with a twist to give constant pitch from root to tip. The aim is that any unit length of the blade should provide the same rate of air displacement as any other.

Other approaches to this problem have been made by Serck Radiators Ltd. and Smiths Motor Accessories Ltd.: in each case the fan operates only when it is needed to regulate the coolant temperature. The Serck-Behr hydrostatic system is already in use on British United Traction railcars and would seem to offer possibilities for the larger underfloor-engines coaches or buses because, since the fan is hydraulically driven, the radiator can be mounted in any convenient position, to suit the overall chassis arrangement.

An engine-driven hydraulic pump feeds fluid to a thermostatically controlled valve. When the valve is closed, the ducted fan is stationary and shutters on the other side of the radiator are closed. A rise in temperature above the controlled level causes the valve to open and fluid flows to the motor on the fan, causing this to revolve; at the same time, fluid pressure is also applied to a piston connected to the shutters, which are thus opened a suitable amount. In this way, the fan speed and radiator aperture are suited to the immediate needs of the engine.

Fundamentally, the Smiths magnetic-particle fan coupling is much simpler, since it does not provide a variable fan speed but is controlled by a thermostatic on-off switch in the bottom tank of the radiator. It is applicable to all fans driven by V-belt or cardan shaft, where the necessary hub diameter and length can be accommodated. Tests have revealed that a normal type of fan may absorb up to 8 b.h.p., and one of tropical pattern may take as much as 20 b.h.p. However, in temperate conditions, it is only essential for cooling purposes for perhaps 5 per cent of the total running time. Apparently, therefore, Smiths' claim of worthwhile fuel saving—5 to 10 per cent at a conservative estimate—should be borne out in practice.

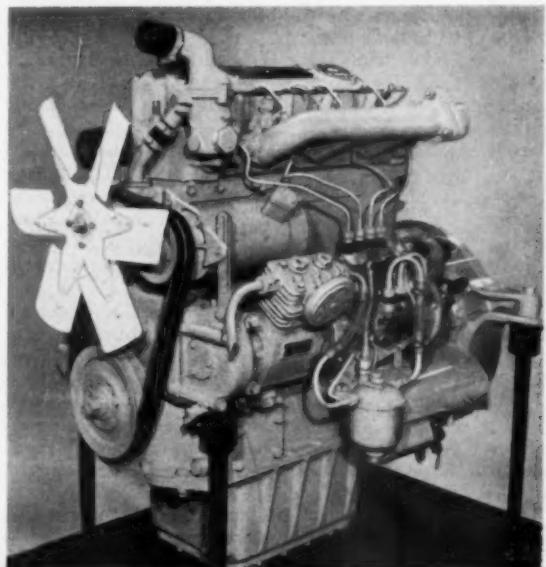
The basic principle of operation is identical with that of the already well known transmission coupling. There are three basic components: a stationary field coil, an input member splined to the fan driving shaft and an output member carrying the fan. Between the input and output members is an air gap containing the magnetic particles. When the coil is energized the magnetic field causes the particles to solidify in the gap, thereby transmitting the drive from the input to the output member. To avoid hunting under critical operating conditions, the switch is set to cut in and out above and below the nominal coolant temperature; the margin in most instances is 5 deg C each way. Installation should not normally present much difficulty as the coupling is compact and only weighs a few pounds.

Diesel engine builders have long realized the necessity for thorough fuel and lubricant filtration. In the search for longer life between overhauls the need for equally effective air filtration is becoming increasingly appreciated, particularly in the case of underfloor engines, which inevitably operate in dirty conditions. The high efficiency of the large-capacity Purolator dry filters, with their elements of resin-impregnated paper, has resulted in their extended use on air intakes. Several manufacturers, including Gardner, utilize smaller filters of this type for breathers.

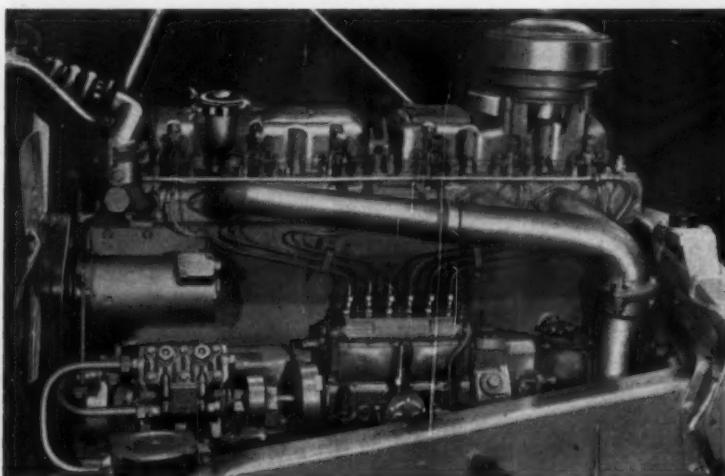
A considerable amount of work has been done in America on pressure die-cast aluminium cylinder blocks and crankcases

for automotive engines. So far, there is no sign of such activities in this country, but the main reason would appear to be the lack of the necessary plant to handle the masses of metal involved. Apart from the saving in weight, which would result from the use of aluminium, the close dimensional control possible with pressure die-casting can reduce machining time by as much as 40 per cent. Cast iron has, of course, the advantage in rigidity, but intelligent design plus the homogeneous structure produced by pressure casting should enable satisfactory results to be obtained in aluminium, where the volume of production justifies the initial outlay on dies and perfection of the casting technique.

A development of much promise is the Glacier Metal Co. Ltd. aluminium-tin bearing, which was described in the June 1958 issue of *Automobile Engineer*. It differs from earlier materials of this type in having a high tin content (20 per cent) dispersed through the aluminium in a reticular structure. This structure provides excellent bearing properties where loading is high, and it is relatively free from scuffing. In comparison with copper-lead, these aluminium-tin bearings have the advantages of freedom from corrosion and of not requiring hardened journals. Also, aluminium



Above: This A.E.C. Maudslay AV312 engine, of 5.1 litres swept volume, is a four-cylinder unit based on the A470 unit with the same bore and stroke dimensions



Left: The wet cylinder liners of the new A.E.C., 11.3 litre, six-cylinder engine are ceramic coated externally for the prevention of corrosion

does not penetrate steel in the manner of copper, so there is no risk of shaft embrittlement. So far only the Fiat company has adopted these bearings but they are being tested by a number of other manufacturers.

#### A.E.C.

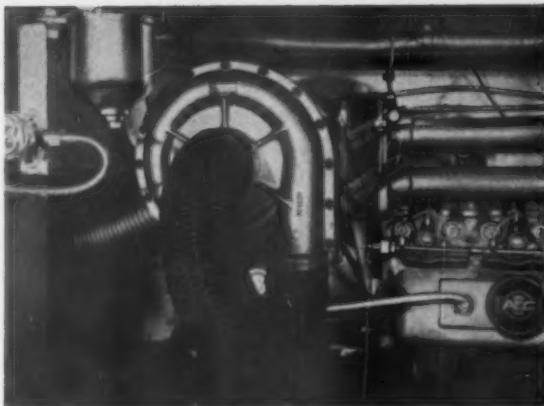
To replace their long-established 9.6 litre and 11.3 litre engines, A.E.C. have introduced two new units of the same capacities, known respectively as the A590 and A690. Although these have the same bore and stroke as their predecessors, 120×142 mm and 130×142 mm, they differ in many respects and are, in fact, extensions of the basic wet-liner design of which the A410 and A470 were the first examples.

Offset toroidal combustion chambers are employed, and they embody the lessons learned by A.E.C. during recent years. The cast iron cylinder heads have renewable valve-seat inserts and the valves feature chromium plated stems and Stellite seating faces. As indicated earlier, the liners have a ceramic coating to resist corrosion. The main and big-end bearings have thick steel shells lined with copper-lead, flashed with lead-tin. Helical gears at the front of the engine drive the camshaft, fuel pump and compressor. Particular attention has been paid to filtration of fuel, oil and air.

The normal governed speed of both engines is 1,800 r.p.m., at which the A590 develops 125 b.h.p. and the A690 150 b.h.p. Torques of 430 and 505 lb-ft are obtained respectively at 1,000 r.p.m. Fitment of a torsional-vibration damper to the crankshaft permits the governed speed to be raised to 2,000 r.p.m., with a 10 per cent increase in output. Vertical and horizontal versions are available and a feature of the A.E.C. design is the ready conversion from one form to the other.

Yet to be fitted to a commercial vehicle is the A.E.C.-Maudslay A312 engine, which is virtually a four-cylinder version of the A470 unit. It has many design features common with the engines just described. The bore is 112 mm (4.41 in) and the stroke is 130 mm (5.12 in), giving a swept volume of 5,123 cm<sup>3</sup> (312 in<sup>3</sup>). A power output of 75 b.h.p. at 2,000 r.p.m. is claimed, with a maximum torque of 218 lb-ft at 1,200 r.p.m.

Shown on the British United Traction stand was a horizontal version of another A.E.C. engine, the 17.89 litre A1100 which, however, is equally suitable for really large road vehicles or earth-moving plant. Also made as a vertical unit, the A1100 follows the same basic wet-liner design as the other engines mentioned. It is a six-cylinder unit, with square bore and stroke dimensions of 156 mm (6.1 in) and



Simms Motor Units Ltd. have installed their Eberspächer turbocharger on the A.E.C. 9.6 litre A590 engine. Although A.E.C. are not associated with the project, they have agreed to supply manifolds to Simms

a compression ratio of 16:1. Whereas the four-cylinder engine has a one-piece cylinder head and single rocker cover, and the six-cylinder units have two heads and covers, the A1100 features a separate head and cover for each cylinder. It also has four valves per cylinder in place of the two valves of the smaller engines. Another difference is the use of a separate pump to circulate the oil through a heat exchanger in the cooling-water system. A maximum power of 275 b.h.p. is developed at 1,900 r.p.m., and the peak torque of 890 lb-ft occurs at 1,300 r.p.m.

On the Plaxtons stand in the coachwork section, there was a bus on an A.E.C. Reliance chassis fitted with a turbocharged version of the A590 engine. The turbocharger is a Simms-Eberspächer unit, and the conversion was carried out by Simms Motor Units Ltd., who estimate the power output to be in the region of 140 b.h.p. Although not officially associated with the project, the engine manufacturers have agreed to supply manifolds to Simms if turbocharging is specified by other customers.

#### Cummins

Two vehicle manufacturers, Seddon Diesel Vehicles Ltd. and Atkinson Vehicles Ltd., have adopted Cummins diesel engines, of American design but now almost entirely built in Scotland. The Seddon Sirdar M tractor features the 11 litre HF-6 engine, a six-cylinder unit having a bore of



Another example of the application of a turbocharger is this Cummins NRTO-6, 335 b.h.p. engine exhibited by Atkinson. The PT fuel system is unique to Cummins

122.8 mm (4½ in) and a stroke of 152.4 mm (6 in). Its power output is 178 b.h.p. at 2,100 r.p.m. and the peak torque is 490 lb-ft at 1,350 r.p.m. On the Atkinson stand was an example of the turbocharged NRTO-6, another six-cylinder engine, with the same stroke but a bore of 130.2 mm (5½ in). This unit produces 335 b.h.p. at 2,100 r.p.m., and at 1,600 r.p.m. the torque is 900 lb-ft. The turbocharger is still an American component.

Both engines embody a number of interesting features including four valves per cylinder. Each pair of valves is actuated by a single rocker through a sliding T-member, which bears on both valve ends. Toroidal combustion chambers are employed but the toroid occupies nearly the full diameter of the piston and its centre is of conical form. Replaceable wet cylinder-liners are employed. The seven-bearing crankshaft has induction-hardened journals and drives the camshaft through helical gears; roller type cam-followers are used.

Perhaps the most unusual features of all, though, is the PT, or pressure-time, fuel system, which is exclusive to Cummins. Its principle of operation is the controlling of the amount of fuel fed to the injectors by regulating the pressure applied by the fuel pump. A gear type pump is employed and the pressure-regulating valve is controlled by the throttle. The fuel-system components are still imported from the parent company.

#### Daimler

Latest version of the 8.6 litre six-cylinder CD 6 Daimler diesel engine is the Mark VIII, which is available both in normally aspirated and turbocharged forms. Its bore and stroke are still 114.3 mm (4.5 in) and 139.7 mm (5.5 in), but numerous modifications have been made to improve performance and life. The most important of these changes are increases in the crankpin and main-bearing journal diameters, the adoption of steel-backed, copper-lead bearings with an indium flash, more rigid connecting rods and improved inlet porting.

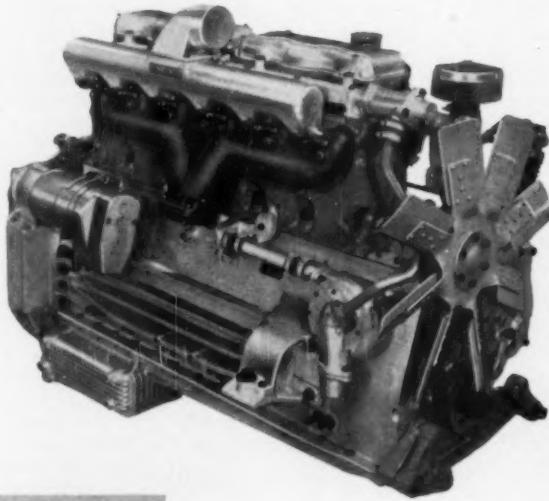
An oil seal of piston ring pattern replaces the scroll seal previously employed at the rear end of the crankshaft. To eliminate a local hot-spot, an additional water pipe has been led from the pump to the rear of the block, between numbers five and six cylinders. The timing and auxiliary drives are at the rear of the engine and the valves are actuated from the relatively high-mounted camshaft by tappets and short pushrods. Open combustion chambers are formed by hemispherical depressions in the piston crowns.

The turbocharged version was on display for the first time at Earls Court. A B.S.A. 100/200 unit is employed and is neatly installed high up at the rear end of the engine. It is fed by a double-entry exhaust manifold embodying a spherical coupling between the front and rear sections, to permit either to be removed without disturbing the other. There is force-feed lubrication for the blower bearings.

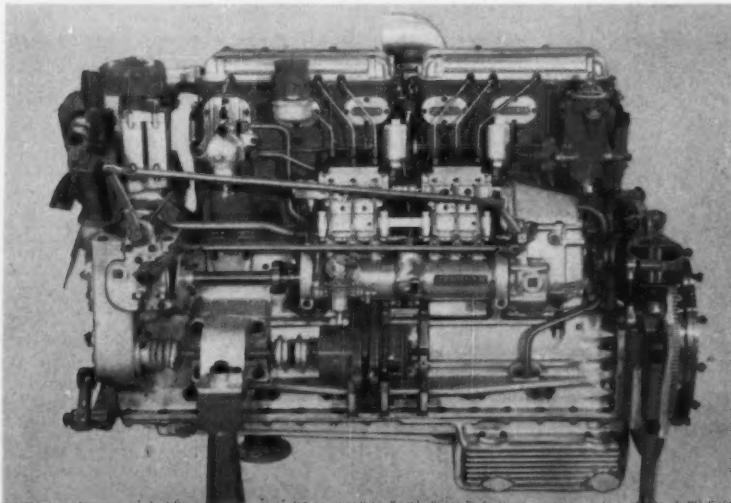
Such is the efficiency of this compact turbocharger that Daimler Co. Ltd. claim a power increase of up to 30 per cent to be possible, with a proportionate gain in torque. However, to give a worthwhile reduction in fuel consumption, 5 per cent, the power improvement is in this instance held to 20 per cent. Comparative power and torque figures of the two versions are: normally aspirated, 125 b.h.p. at 2,000 r.p.m. and 358 lb-ft at 1,250 r.p.m.; turbocharged, 150 b.h.p. at 2,000 r.p.m. and 440 lb-ft at 1,250 r.p.m. It will be noted that there is no rise in the peak-torque r.p.m. with turbocharging, a fact which is indicative of the good medium-speed performance of the blower.

#### Fodens

In the Mark III form, the Foden supercharged two-stroke diesels have an increased maximum speed of 2,400 r.p.m., at which the six-cylinder FD6 produces 150 b.h.p. and the four-cylinder FD4 100 b.h.p. The respective torque

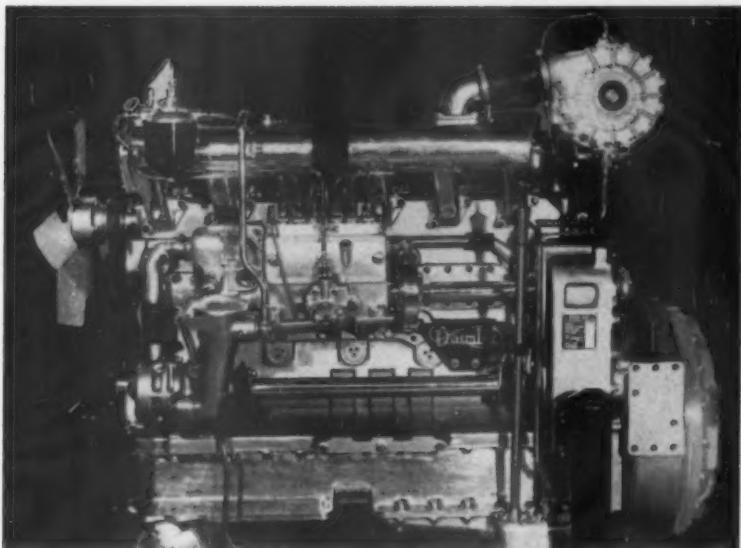


Above: This three-quarter front view of the Gardner 6LX engine shows the 24 in diameter cooling fan, which has eight blades, runs at engine speed and is claimed to absorb only 2.8 b.h.p.



Left: Gardner 6LX, 10.45 litre, 150 b.h.p. engine. This six-cylinder unit gives a high performance and has good thermal efficiency; a single casting is employed for the complete cast iron cylinder block

Among the more important of the changes that have been made to this Daimler CD 6, turbocharged engine are increases in crankpin and main-bearing journal diameters, the adoption of steel-backed copper-lead bearings with an indium flash, more rigid connecting rods and improved inlet porting design and arrangement



figures are 365 and 244 lb-ft at 1,500 r.p.m. Like their predecessors, the engines have a Roots-type supercharger and employ uniflow scavenging: gas is delivered through ports in the cylinders and exhausted through poppet valves in the heads. The exhaust valves are push rod operated from a camshaft. This shaft, together with the fuel pump, blower and dynamo, is driven by a helical gear train at the rear of the engine.

The higher maximum operating speed has been obtained by a marked increase in crankshaft journal diameter, which has raised the shaft critical speed. This increased journal size has been made possible by virtue of a change of main-bearing design from thick white-metal lined shells to the thin-wall, copper-lead pattern, with a lead-indium flash. As before, the crankcase and cylinder block are a light alloy casting, and the separate iron cylinder heads seat on copper rings. The bolts holding down the heads extend through the block to the main-bearing caps.

Consequent upon the change in bearing material is an increase in the permissible lubricating-oil temperature to 200 deg F, which has not only improved thermal efficiency but also enabled the separate oil section in the main radiator to be dispensed with, in favour of a heat exchanger in the cooling-water system. The fuel pump camshaft is now pressure lubricated from the engine oil pump, and the fuel filters are on the pressure side of the lift pump. Other specification changes from the Mark II include the use of a wax type thermostat in place of the bellows variety.

The bore and stroke dimensions of both engines are 85 mm (3.35 in) and 120 mm (4.73 in) respectively, giving capacities of 4,090 cm<sup>3</sup> (250 in<sup>3</sup>) and 2,724 cm<sup>3</sup> (166 in<sup>3</sup>). A compression ratio of 14:1 has been adopted and net weights, less electrical equipment, are 1,236 and 1,009 lb.

#### Gardner

A new engine from a firm with the experience and reputation of L. Gardner and Sons Ltd. is worthy of close study. At first glance, the 6LX bears a close resemblance to the world-renowned 6LW, with which it has been made interchangeable, but it is in fact of considerably greater capacity—10.45 litres as against the 8.4 litres of the 6LW engine.

The increased size has been obtained by enlarging the bore by  $\frac{1}{8}$  in to 4 $\frac{1}{2}$  in (120.6 mm). To avoid any overall increase in length, there has been a departure from accepted Gardner practice in that the cylinder block is now a single casting.

This arrangement, of course, saves length to the extent of the wall thicknesses of the 6LW block castings and the air space between them. Twin cylinder-head castings are retained, as also is the stroke of 6 in (152.4 mm).

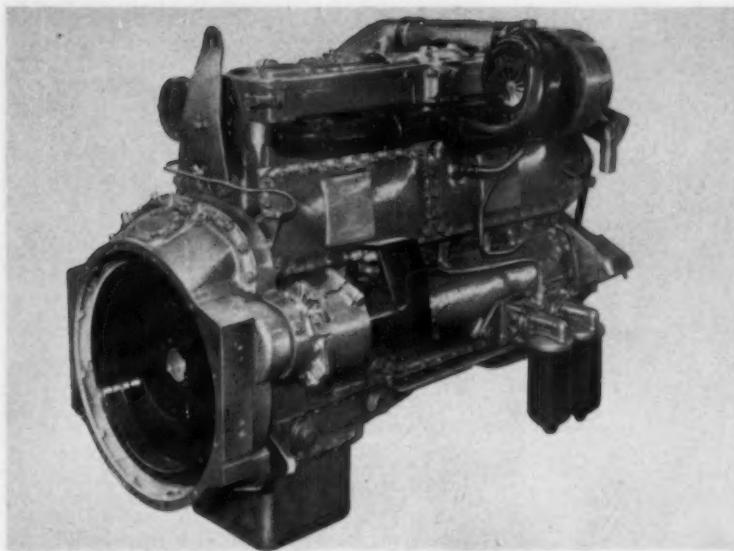
To cope with the greater power output, the main-bearing journals and crankpins are of larger diameter than those of the 8.4 litre engine. The shaft is not hardened and, though the makers continue to favour white-metal in bronze shells for the main bearings, the big-end bearings are now of the thin-wall type with copper-lead linings having a lead-tin overlay. Familiar Gardner features include a deep-section aluminium-alloy crankcase, extensively ribbed, and hemispherical combustion chambers formed in the piston crowns; the compression ratio is 14:1.

The 6LX embodies the results of intensive development work on breathing, combustion and the minimizing of power wastage, both internal or external. As already mentioned in the introductory paragraphs, friction has been reduced by the use of only two compression rings and one scraper, and the low-consumption fan has eight blades and a diameter of 24 in. The fuel-pump mounting differs from that of the 6LW and the pump is equipped with a Gardner-made camshaft, which provides a slower and longer injection, intended to reduce combustion noise.

That the development work has been highly successful is witnessed by the combination of high power output and remarkably low fuel consumption which has been achieved. The power developed is quoted as 150 b.h.p. at 1,700 r.p.m., and the torque is 485 lb-ft at 1,000 to 1,100 r.p.m.—the highest specific torque figure of any British four-stroke diesel to date. Moreover, the lowest specific fuel consumption, which occurs near the peak torque speed, is no more than 0.314 pt/b.h.p.-hr, equivalent to a thermal efficiency only just below 40 per cent. Add to these figures a dry weight of 1,583 lb (10.7 lb/b.h.p.) and the answer is a very impressive addition to the Gardner range of engines for commercial vehicles.

#### Leyland

The newly introduced Leyland Super Comet range is powered by the six-cylinder O.375 diesel engine which is an enlarged version of the O.350 of the Comets. In this engine, the stroke is unaltered at 120.7 mm (4.75 in), but the bore has been increased by 3.4 mm to 104 mm (4.1 in), giving a capacity of 5.76 litres; the compression ratio remains at 16:1. The crankshaft dimensions are as on the O.350,



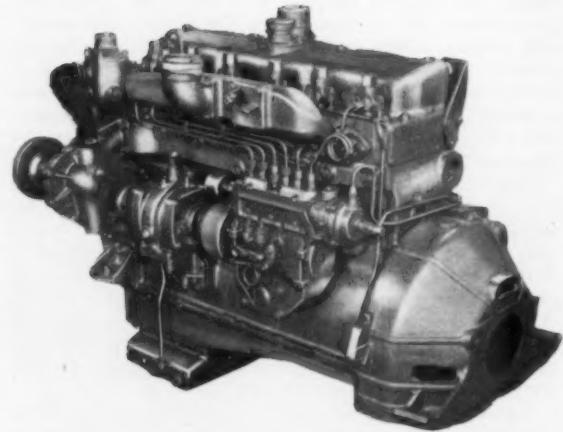
Left: Meadows 6DCS630, 10.35 litre engine equipped with a Holset-Schwitzer turbo-charger. The power output is 200 b.h.p.

Below: The Perkins F340, six-cylinder, 5.56 litre engine, which has been developed from the R6 unit, is used on the Ford F600 truck

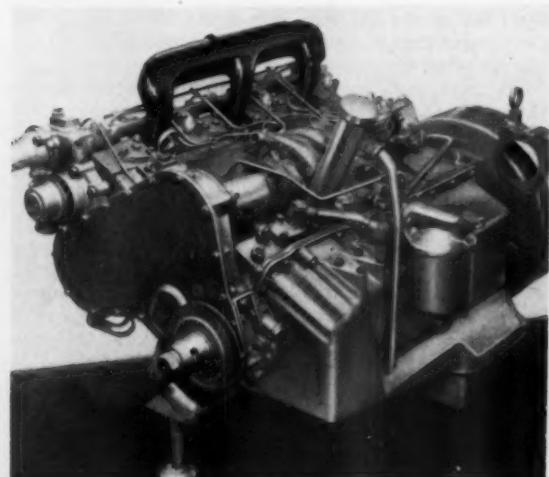
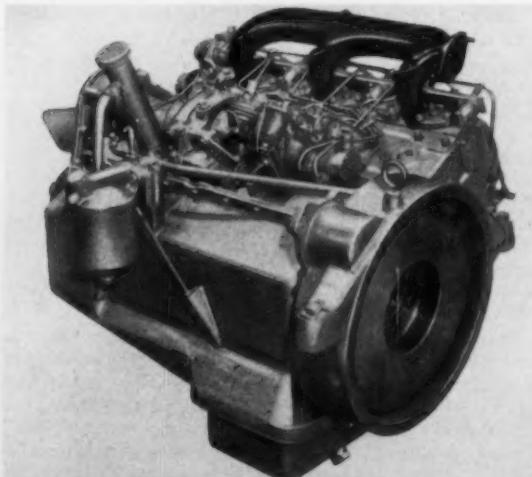
and other Leyland features retained include push-fit dry cylinder liners, toroidal combustion chambers in the piston crowns, offset gudgeon pins and gear-driven camshaft and auxiliaries.

Alterations on the larger unit comprise redisposition of the dynamo, lubricating-oil filter and exhaust manifold—to give good accessibility with the modified cab layout of the Super Comets—and the introduction of a paper-element fuel filter between the lift and injection pumps. The power output of the O.375 unit is 110 b.h.p. at the maximum governed speed of 2,400 r.p.m.—5 b.h.p. more than the O.350—and the torque is 285 lb-ft at 1,100 r.p.m.

Minor changes have been made to the 11.1 litre underfloor engine of the Worldmaster bus and coach chassis. Improvements to the filtration of intake and breathed air should help to give long life in dusty conditions. The cooling system has undergone considerable change to ensure a quick warm-up in cold conditions without overheating in tropical climates. One of the improvements is pressurization to



The two views below are of the Perkins C305, 5 litre engine for underfloor installation. This engine is based on the P6 unit but has thin-wall steel liners, giving it a larger bore, and a distributor type fuel injection pump; the cylinder axes are set at an angle of 24 deg to the horizontal



4 lb/in<sup>2</sup>, and the flow rate has been increased to the block as well as the head; there is a no-loss side-tank into which coolant is forced if the pressure exceeds the nominal figure.

British United Traction railcars supplied to Northern Ireland are powered by the Leyland 15.2 litre six-cylinder engine, of 139.7 x 165 mm bore and stroke, fitted with a Simms-Eberspächer turbocharger. This is the power unit featuring the Serck-Behr hydraulic fan control mentioned earlier. An impressive power output, of 275 b.h.p., is obtained at 1,800 r.p.m.; at 1,250 r.p.m. the torque is 867 lb-ft.

### Meadows

Two new six-cylinder diesel engines manufactured by Henry Meadows Ltd. have much in common, although one is a normally aspirated unit of 11.38 litres capacity and the other is a turbocharged 10.35 litre engine. Both stem from the 6DC630 of which the turbocharged engine, the 6DCS630 is a high-output variant. In each case the bore is 130 mm (5.118 in), but whereas the 630 engines have square bore and stroke dimensions, the stroke of the 700 is increased to 143 mm (5.63 in). To enable the same integral crankcase and cylinder block casting to be used for both engines, the longer stroke unit has shorter pistons.

The combustion chambers are of open type, formed by a toroidal depression in the piston crowns. On the 700, the compression ratio is 16:1, as on the unblown 630, but that of the turbocharged 630 unit is reduced to 15:1. A Meadows feature is that the helical gear drive to the camshaft, as well as that to the fuel pump and generator, is at the rear of the engine. The S630 is equipped with a Holset-Schwitzer turbocharger of the double-entry type, normally mounted on the right-hand side of the engine. For installations where width is critical, there is an alternative location above the engine.

Power output and torque figures quoted for the two new units are as follows: 6DC700, 165 b.h.p. at 2,000 r.p.m. and 470 lb-ft at 1,200 r.p.m.; 6DCS630, 200 b.h.p. at 2,000 r.p.m. and 568 lb-ft at 1,400 r.p.m. Three other Meadows engines—the unblown 6DC630, the 6DC500, vertical and horizontal, of 8.14 litres and the largely similar 5.423 litre four-cylinder 4DC330—have all been uprated by approximately 10 per cent. On the last of these, a distributor type fuel pump, with a centrifugal governor, replaces the in-line pump.

### Perkins

Of the three F. Perkins Ltd. novelties only one engine, the Four 99, is really new in the sense of not being derived from another unit. Adopted by Trojan Ltd. and Beardmore Motors Ltd., the Four 99 is a compact 1.6 litre (99 in<sup>3</sup>) four-cylinder designed to combine high-speed operation

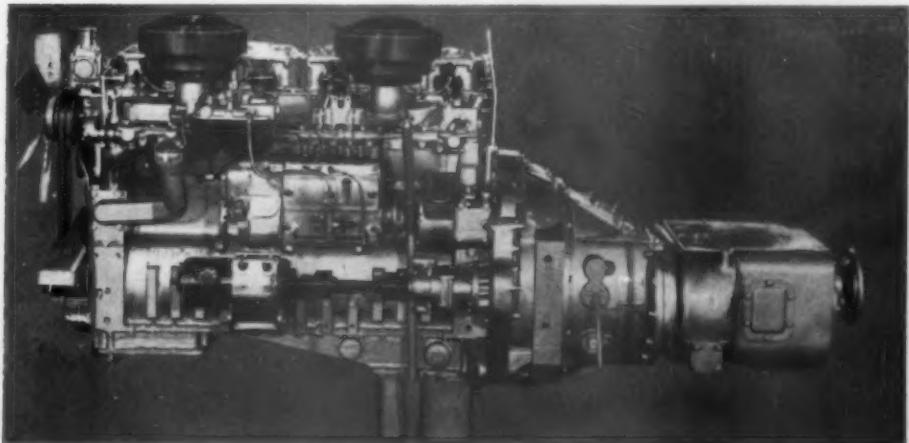


In the Standard Atlas van, the 948 cm<sup>3</sup> engine is inclined 10 deg to the left from the vertical, to suit the forward control layout

with refinement of running and a low noise level. Its bore and stroke are 76.2 mm (3 in) and 88.9 mm (3.5 in) respectively, and the compression ratio is 20.0:1. The maximum rating, for car use, is 43 b.h.p. at 4,000 r.p.m.; for commercial vehicles, the engine is derated to give 42 b.h.p. at 3,600 r.p.m.; there is also an industrial variant giving 32 to 35 b.h.p. at 3,000 r.p.m. Peak torque occurs at 2,250 r.p.m. in both automotive forms, and at 2,000 r.p.m. in the industrial unit. For the power output, the bare weight of 320 lb is very moderate.

To suit the high speed of operation, a new combustion system has been developed and patented. Though still of the swirl chamber type, the design differs from that of other Perkins engines: the hemispherical upper part of the chamber is machined in the cast iron cylinder head and the lower half, of flattened form, is machined in a plug inserted into the lower face of the head. In this plug is the oval-section port to the cylinder. A further change is the use of a pintle-type injection nozzle in place of the two-hole variety.

The wet cylinder liners are flanged at the top and sealed



The Meadows 6DC700, six-cylinder 11.38 litre engine has the same external dimensions as the 6DC630, 10.35 litre unit; its bore is also the same but it has a longer stroke

## London Show Review

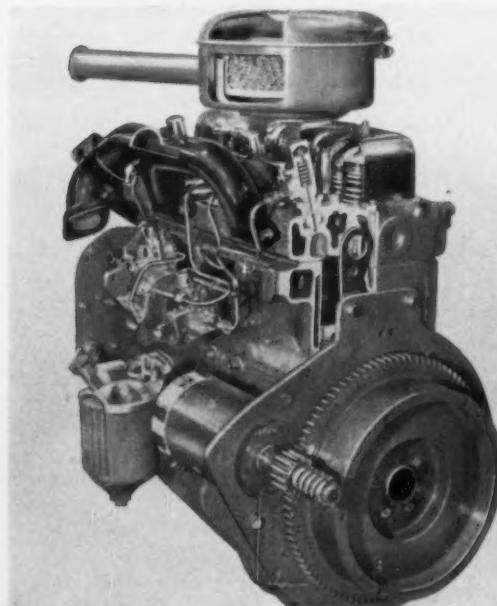
The Motor Show number of *Automobile Engineer* will be published on Wednesday, the 26th of November. It will constitute a critical review of the more interesting exhibits and will have numerous illustrations of special features and design characteristics. This special issue can be obtained by order from newsagents throughout the United Kingdom, price 3s 6d net. Readers are reminded that it is necessary to make arrangements with a newsagent to ensure that a copy is secured.

by a synthetic-rubber ring at the bottom. Forged in En 19T steel, the counterweighted crankshaft has three main bearings which, like the big-ends, have lead-bronze steel-backed liners; wrapped lead-bronze small-end bushes are employed. The camshaft is mounted low in the right-hand side of the crankcase, and is driven by helical gears. It actuates the valves through pushrods and forged-steel rockers. Lubrication is by eccentric-lobe pump.

Flange-mounted on the left-hand side on the rear face of the timing case, the C.A.V. distributor-type fuel pump is equipped with a hydraulic governor. Both the water pump and generator are driven by V-belt, and a thermostat is incorporated in the cooling system. Cold starting is facilitated by a C.A.V. Thermostart heater in the induction manifold.

The second engine, the 5 litre C305 is an underfloor six-cylinder unit, which has been taken up by the Rootes Group for fitment to the new forward-control 4 ton Commer truck. It is also offered as optional initial equipment on the forward-control 5 ton and 6 ton Commers and the Karrier Gamecock. A development of the familiar 4.73 litre P6 engine, the C305 has an enlarged bore of 91.44 mm (3.6 in), but the stroke remains the same at 127 mm (5 in); the compression ratio is 17.4 : 1. An increase of 4 b.h.p. has been obtained relative to the P6 engine, the later version developing 87 b.h.p. at 2,400 r.p.m., and a gross torque of 216 lb-ft at an engine speed of 1,300 r.p.m.

*This view of the Perkins Four 99 shows the new combustion chamber and the arrangement of the distributor type fuel injection pump*



For an underfloor design, the engine is unusual in that the cylinder axes are inclined at 24 deg to the horizontal. The cylinder liners are of the steel thin-wall pattern with chromium plated bores, a feature which has permitted the increased bore and is claimed to provide exceptionally long life. To suit the altered angle of installation, the lubrication system has been modified in several respects relative to the P6. An eccentric-lobe pump is used. Valve operation is by a high mounted camshaft, tappets and rockers; the camshaft driving chain is tensioned by a Renold SCD Type 2 hydraulic adjuster. A departure from previous practice is the use of rockers fabricated from steel pressings.

The combustion chambers are of the normal Perkins type, with half the swirl chamber sphere in the head and the other half in a detachable steel cap in the side face of the head. The C305 is believed to be the first production six-cylinder engine equipped with a distributor type fuel pump, which is flange-mounted on the upper side of the engine and embodies a hydraulic governor.

That the 5.5 litre F340 should have been adopted by Ford Motor Company Ltd., for the F600 truck, reflects much credit on F. Perkins Ltd. This engine has the same bore and stroke, 101.6 mm (4 in)  $\times$  114.3 mm (4.5 in), as the R6, from which it has been developed, and its compression ratio is 17.5 : 1. From the output of the R6, 102 b.h.p. at 2,400 r.p.m., the F340 has been uprated to give 110 b.h.p. at 2,850 r.p.m., without the vacuum pump, and its gross torque is 240 lb-ft at 1,700 r.p.m.

Because of the necessity of minimizing overall length to suit the Ford installation, the water pump is side-mounted, ahead of the exhaust manifold on the left of the engine, instead of projecting forward as on the R6. Length has been further saved by using a single-belt drive to the water pump and generator, a change made possible because the customer supplies V-belts to U.S.A. performance rating, which is higher than that used in this country.

The C.A.V. AA in-line fuel pump used is larger than that of the R6, and its drive embodies an automatic advance-retard device. An interesting refinement indicative of the probable wide range of operating conditions is a pressure-sensitive control, which reduces the maximum fuel delivery with increasing altitude. It is anticipated by Perkins that a version of the F340 engine, for other users, will be introduced at a later date.

### Standard

The new Standard Atlas 10/12 cwt van and truck is fitted with a version of the well-established 948 cm<sup>3</sup> (63  $\times$  76 mm) petrol engine employed on Ten and Pennant cars. To enable forward control to be used, the engine is canted 10 deg to the left, and most of the modifications have been introduced because of this. The inlet and exhaust manifolding has been altered, as has the dipstick, and the distributor mounting has been changed to retain accessibility. Also, the engine mounting arrangements have been varied because of the inclined installation.

To permit the use of lower-grade fuels, the compression ratio is 7.0 : 1 whereas that of the car unit was raised some time ago from that figure to 7.5 : 1. The power output of the Atlas version is 33 b.h.p. at the same speed, 4,500 r.p.m., as for the car engine.

### Thornycroft

Modifications to the Simms-Eberspächer turbocharging arrangements have resulted in the uprating of the 11.33 litre six-cylinder Thornycroft KRN6/S diesel engine, to 230 b.h.p. at 1,900 r.p.m., from the earlier figure of 200 b.h.p. at the same speed. The torque has been correspondingly increased from 625 to 700 lb-ft at 1,000 r.p.m. No appreciable changes have been made to the power unit itself since it was described in the Feb. 1957 issue of *Automobile Engineer*.

New since the last Commercial Motor Show is the NS6 7.88 litre six-cylinder engine fitted to the Mastiff chassis. It has been developed from the NR6/MV unit and has the same bore and stroke, of 104.8 mm (4½ in) and 152.4 mm (6 in). The power output of 115½ b.h.p. gross at 1,800 r.p.m. is nearly 10 per cent higher than that of the NR6, and the maximum torque, 354 lb-ft at 1,000 r.p.m., is some 19 lb-ft higher.

Much emphasis has been placed on quietness of running, attained by rigid construction, careful design of cam contours and valve gear, and good combustion characteristics. The timing and auxiliary drives, at the front of the engine, are a combined chain and gear system. The crankshaft is nitrided and runs in seven, steel-backed, copper-lead bearings, a type that is also used for the big-ends. Replaceable dry cylinder liners and toroidal open combustion chambers are other features.

#### Miscellaneous

No new power units or changes of any importance can be reported from B.M.C., Ford or Bedford. The performance of the small Commer vans has been increased by the adoption of the 1,494 cm<sup>3</sup> (79 x 76.2 mm) overhead-valve petrol engine, which was introduced recently on the latest Hillman Minx. It replaces the earlier 1,390 cm<sup>3</sup> unit. The stroke is the same as on the smaller capacity engine, which had square dimensions.

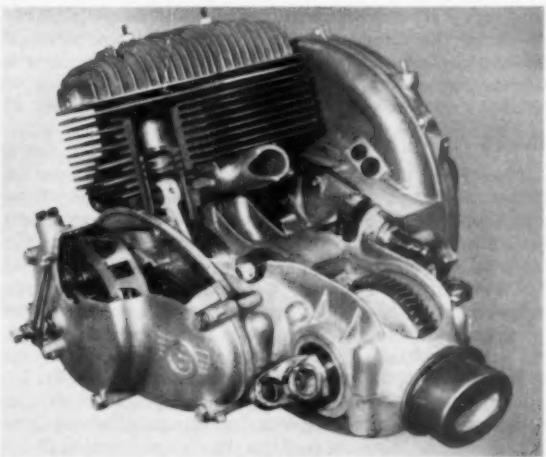
The three-bearing crankshaft is still carried in white-metal

steel-backed bearings, but in view of the increased loadings, the big-end bearings are now of copper-lead. To permit the use of lower-grade fuels, the compression ratio is 7.0 : 1 instead of the 8.5 : 1 of the car engine, the lower ratio being obtained by the use of concave-crown pistons. The gross b.h.p. is 49 at 4,200 r.p.m., as against the 52.5 at 4,400 r.p.m. of the car unit, and the torque is 73.7 lb-ft at 2,200 r.p.m.

No major changes have been necessary on the interesting Roots-supercharged, three-cylinder, two-stroke Commer engine, with opposed-pistons and rockers. This engine was fully described in the August 1954 issue of *Automobile Engineer*. A minor improvement is the use of an automatic, hydraulically controlled tensioner, in place of the previous manually adjusted pattern, for the auxiliary-drive chain. The gross b.h.p. is 105 at 2,400 r.p.m., and at 1,200 r.p.m. the torque is 270 lb-ft.

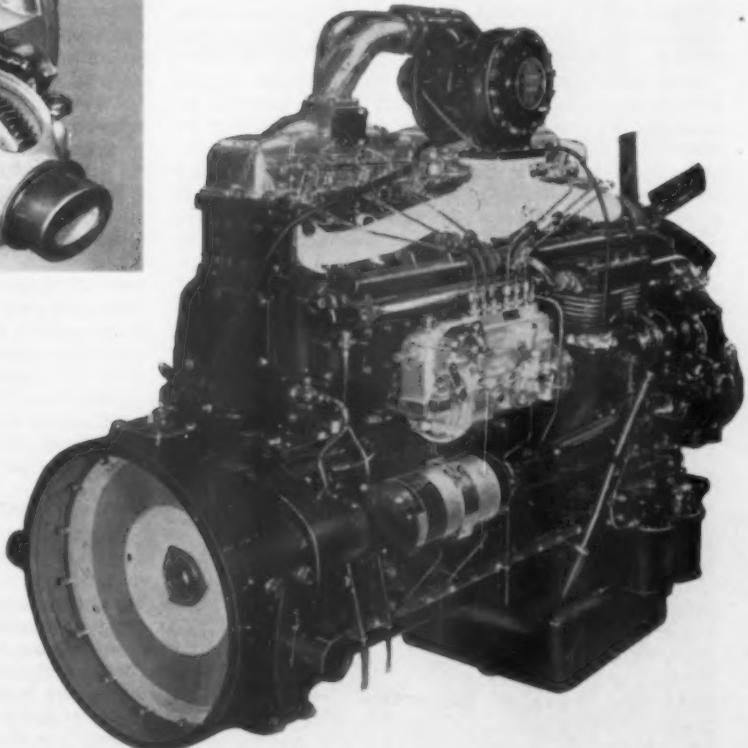
Continental support at the Show was confined to four manufacturers: Volkswagen and Hans Glas from Germany and Tatra and Skoda from Czechoslovakia. The Glas Goggomobil twin-cylinder two-stroke engine, the smallest in the show, is already familiar as the power unit of the miniature car from the same factory; it now powers a neat 5 cwt van. This engine is an orthodox loop-scavenged, parallel twin unit with 180 deg cranks. It has a bore of 58 mm and a stroke of 56 mm, giving a swept volume of 293 cm<sup>3</sup>; a 67 mm bore, 392 cm<sup>3</sup> version is also made, but is not imported. The power output is claimed to be 15 b.h.p., and the drive is transmitted through helical gears to an electro-magnetic gearbox in unit with the engine.

The Tatra air-cooled V-twelve diesel, of 14.825 litres, was seen at the 1956 Commercial Motor Show and is notable for having a belt-driven axial-flow cooling fan for each ducted bank of cylinders. Also previously exhibited at Earls Court is the 11.781 litre Skoda diesel, a water-cooled in-line six-cylinder unit with, as far as could be ascertained, no outstanding new features. It develops 170 b.h.p. at 1,900 r.p.m., whereas the Tatra output is 180 b.h.p. at 1,800 r.p.m.



The Goggomobil 293 cm<sup>3</sup> engine was the smallest exhibited at the Show. It is an air-cooled, parallel twin-cylinder, two-stroke unit; the clutch is directly coupled to the crankshaft and the transmission incorporates a secondary reduction gear and a differential assembly

With the Simms-Eberspächer turbocharger installed, the Thornycroft KRN6/S, 11.3 litre, six-cylinder engine is uprated to develop 230 b.h.p. at an engine speed of 1,900 r.p.m.



## CLUTCHES

### *Further Development of Well Established Units, and an Extension of the Use of Hydraulic Actuation*

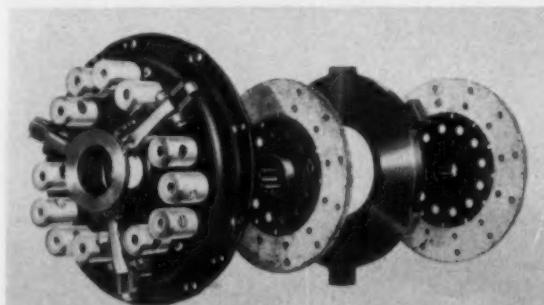
AMONG the many different exhibits at Earls Court, the majority of vehicles of various sizes had an orthodox friction clutch with foot pedal operation, the gear shift being effected manually. It is probable that this will continue for some time, as this type of arrangement has definite economic advantages. Therefore, there is continued interest in the development of the normal friction clutch, which has been steadily improved over a number of years.

Borg and Beck Ltd. exhibited the full range of their well known single-dry-plate clutches, from 6½ in diameter up to 16 in diameter. These include rigid types and those with spring-drive centre-plates. The A.S. type strap-drive clutch is now available in the 12 in and 13 in diameter sizes; pressed cover plates are now employed for the larger sizes of these clutches, 12 in, 13 in, and 14 in diameter, for commercial vehicles. In all of these clutches, the drive is transmitted from the cover to the pressure plate through four pairs of tempered steel straps. One end of each pair of straps is riveted to the cover flange, while the other is bolted to the pressure plate. These straps are arranged tangentially, so that they can deflect as the clutch is released, without disturbing the concentricity of the pressure plate. Thus, accurate balance is maintained throughout the full range of travel of the clutch levers. Friction, rattles or other noise in the actual drive are eliminated, because there is no sliding or rubbing contact between the pressure plate and the cover.

In suitable applications, a driven plate having a spring-drive near the centre and cushioning between the friction surfaces, provides a smooth take-up of the drive and damps out torsional vibrations between the power unit and the gearbox.

Borg and Beck also offer a new 10 in diameter integral main drive clutch and power take-off. This is intended for applications where it is necessary or desirable to provide, by means of a single pedal, independent control of the main drive to the wheels, and to the power take-off. This unit consists of two independent clutches mounted in tandem in a single pressed steel cover, which is bolted to the flywheel. The cover contains the main and intermediate pressure plates, which are of generous size to assist in the dissipation of heat. The remainder of the clutch is based on Borg and Beck general design practice. A single ball-thrust release

*Borg and Beck integral main drive and power take-off clutch. The plate adjacent to the flywheel transmits the drive to the power take-off, while the other plate serves the main drive to the transmission*



mechanism is provided for the operation of both clutches. The clutch adjacent to the flywheel transmits the drive to the power take-off, while the other clutch serves the main drive. Both clutch plates are of the rigid type and are fitted with heavy-duty, woven metal-reinforced friction facings.

Small and Parkes Ltd. and Laycock Engineering Ltd. also exhibited respectively their Don and Layrub clutch centre plates, both of which embody a flexible drive. In each case, rubber is used as the flexible medium. An advantage of the use of this material is inherent damping.

An interesting form of clutch, designed on the lines of a fluid flywheel, but employing a dry medium, made by Powder Couplings Ltd. was exhibited on the stand of Specialloid Ltd. It is a centrifugal coupling. The dry medium is very fine, heat treated, steel shot. A housing is fixed to the drive side of the coupling and, inside it, a hardened steel rotor is coupled to the output side. Both members are free to rotate independently of each other when the coupling is stationary. As the speed of the coupling is increased, the steel shot is thrown outwards by centrifugal force, gradually taking up the drive, until there is practically no slip. If this clutch were to be applied to vehicle transmissions it would appear that the gear changes would have to be effected by means of a separate clutch.

#### Clutch Operation

For foot operation on the smaller vehicles, it is becoming almost standard practice to use hydraulic actuation of the clutch operating lever on the gearbox. This arrangement is currently employed both with pendant pedals and with the more orthodox type, pivoted below the foot. The use of hydraulic operation has many advantages. It is not only self-adjusting and self-lubricating, but avoids a large number of mechanical joints in the control, with their lubrication and noise problems. It also forms an extra vibration insulation element between the power unit and the body.

An interesting actuation arrangement is provided with the new Borg and Beck main drive and power take-off clutch mentioned earlier. With the pedal in the free position, both the main drive and the power take-off clutches are engaged. When the pedal is depressed to an intermediate position, the main drive clutch is disengaged, but full torque continues to be transmitted to the power take-off. Full depression of the pedal disengages both clutches, so allowing the engine to run free. This control and clutch, therefore, permit simultaneous operation of the main drive and the power take-off, or of the power take-off only; alternatively, of course, they can both be disengaged simultaneously.

#### Semi-automatic transmission controls

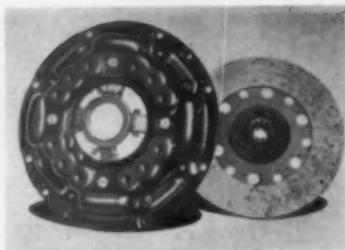
In conjunction with the normal friction type clutch and the layshaft type gearbox, a number of two-pedal control schemes, such as Manumatic, Newtondrive, Standdrive and Saxomat, have been available for some time. In these systems, the operation to engage and disengage the clutch is effected by a servo mechanism, so the clutch pedal can be obviated. However, the actual gear changing still has to be done by means of a lever. An obvious advantage of this two-pedal control is that it enables more foot room to be provided on the toeboard, and permits the brake pedal pad to be made

larger so that it can be operated by the left foot, if desired.

Although some drivers feel that the omission of the clutch pedal gives no benefit in the way of reducing the number, or bother, of hand gear shifts, other users of these two-pedal controls have obtained satisfactory results. A number of vehicle manufacturers in the small and medium range have recently offered one of these systems as an optional extra, at a price considerably less than would be required for a fully-automatic transmission. It is believed that the number of vehicles so fitted has not been large, and this may, perhaps, be a pointer to future transmission requirements.

Automotive Products Co. Ltd. have brought out an improved version of their Manumatic system, which now includes a lock-up feature. This addition to the well known basic system consists of a vacuum servo, formed integrally with the clutch servo, a small solenoid operated, control valve and a pair of switches. One switch is controlled by the

This is the Borg and Beck, 14 in diameter, A.S. type clutch, which is now available also in the 12 in and 13 in diameter sizes



accelerator pedal, and the other is sensitive to the particular gear that is engaged. In operation, this lock-up system prevents unnecessary disengagements of the clutch and thus improves the all-round control of the transmission.

## GEARBOXES

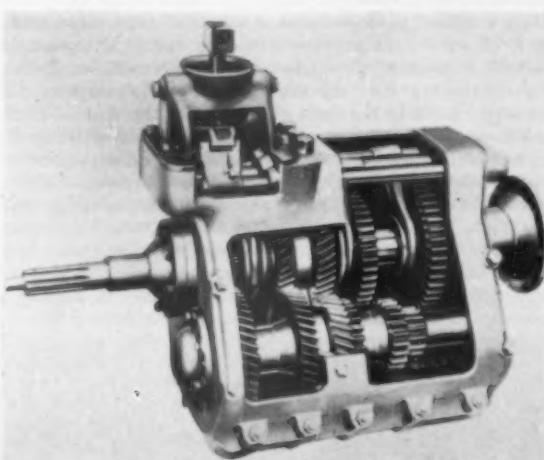
*New and Modified Gearboxes to Meet the Demand for More Ratios, and Steady Development of Automatic and Semi-Automatic Transmissions Has Continued Since the Previous Show*

ON nearly all the smaller types of commercial vehicles at the Show, synchromesh gearboxes already in production for cars are employed. Some are of the three-speed type, while others have four speeds. On the Bedford 10/12 cwt light van, the three-speed gearbox now has synchromesh on all the gears, including first speed. Because they are required for use in cars, these small types of gearbox generally have helical gears for most of the ratios, so a satisfactory degree of silence is obtained.

There is not much uniformity in the type of gears used on the larger truck gearboxes. In some instances, helical gears are used for the higher ratios, and straight teeth for the lower ones; in other instances, straight teeth are used for all the gears, and dog engagement is employed for the higher gear ratios. This latter practice obviates axial thrust and the tendency to canting of the gears, which can cause disengagement. So far, extreme silence has not been an important factor on this type of truck. The main requirement is that the unit be robust and reliable, and thus need a minimum of service attention. Developments seem to indicate that these types of manually operated gearboxes, together with a pedal actuated clutch, will continue in use for some time on trucks in the moderate price range. These units are the most economical types to produce, and this type of change-speed operation is accepted by truck drivers. The provision of five or more speeds is becoming more common, and there were several interesting new gearboxes at the Show.

Commer Cars Ltd. have a new five-speed constant mesh gearbox, which is in production as an option to the standard four-speed box on their 5, 6, 7, and 10/11 ton models, and also on their Avenger passenger chassis. In the case of their 12 ton tractor models, the new five-speed gearbox is standard, and it avoids the need for incorporating an overdrive unit. This gearbox gives fairly close ratios, and this is advantageous, particularly under overseas conditions. To reduce weight, the gear casing is in light alloy.

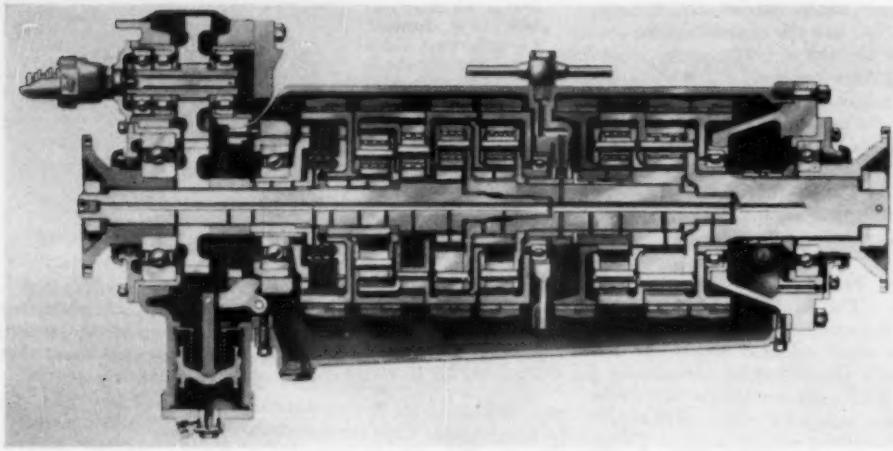
The Moss Gear Co. Ltd. offer a five-speed normal-control gearbox, type 4183, designed for a maximum input torque of 230 lb-ft at 1,000 r.p.m. In this gearbox, the fourth speed is direct, and fifth speed is an overdrive ratio. The constant mesh gears, of the single helical type, have shaved teeth. This manufacturer also produces a new constant mesh, synchromesh, twin-range, six- or eight-



Commer Cars Ltd. have introduced this five-speed constant mesh gearbox, as an option to their standard four-speed box. Since production is undertaken in relatively large quantities this arrangement is more economical than the incorporation of a separate overdrive unit

speed gearbox, offered with or without overdrive. It includes an automatic hill-holding device. The box is also available in a six-speed form suitable for a maximum engine torque of 240 lb-ft, and in eight-speed form for torques up to 300 lb-ft. For ease of assembly and service, the gear casing is split on the plane of the shaft axes.

David Brown Industries Ltd. exhibited a wide selection of transmission units; all except two of these are either new or modified. They include models 542, 542CM, 552, 557CM, 557/480 and 561, all of which have five speeds. In addition, a two-speed epicyclic auxiliary unit is applied on models 557A and 561A to give ten speeds. One of these ten-speed versions has been described in detail in the August 1958 issue of *Automobile Engineer*. These eight gearboxes cover an engine torque range from 250 lb-ft to 750 lb-ft. Single helical gears, with shaved teeth, and dog engagement are



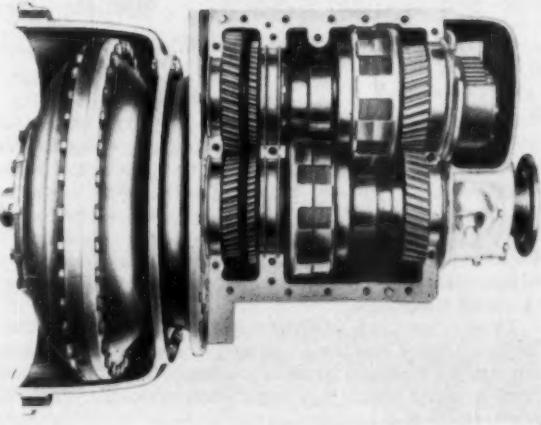
Left: Longitudinal section of the eight-speed gearbox manufactured by Self Changing Gears Ltd. This unit is air actuated

Below: Simplicity is the outstanding feature of the ZF Hydromedia automatic transmission

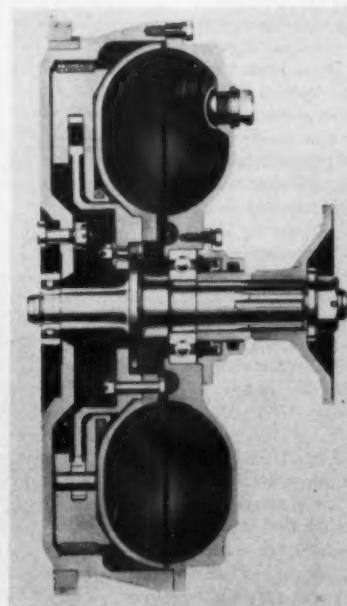
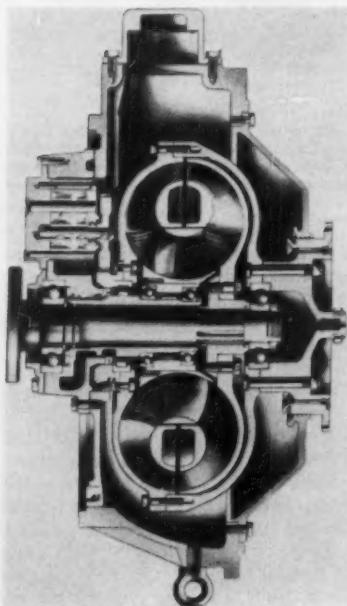
used for most of the forward ratios in these gearboxes.

A new and unconventional 25 cwt vehicle was shown on the stand of Jensen Motors Ltd. This design is based on the Tempo Matador, which has a front-mounted power unit, and front-wheel-drive. It comprises an interesting combination of a B.M.C. 1,500 cm<sup>3</sup> engine, driving through a standard Borg and Beck, 8 in diameter, hydraulically actuated clutch, to a ZF combined gearbox-front-drive unit. This gearbox has silent-running helical gears, and synchromesh for all four forward ratios. The top gear gives a slight overdrive. A remote control in the form of a lever on the dash is used. Substantial weight saving is obtained by combining the whole power unit and drive in one assembly. Another advantage is that the whole weight of the mechanical unit, and the driver, is on the driven wheels, which are independently sprung. This transmission arrangement, which is fairly common on the Continent, is good from many points of view.

On the A.E.C. Mammoth Major and other models of this make, there is a choice of either a five- or six-speed constant mesh gearbox with synchromesh. Albion Motors

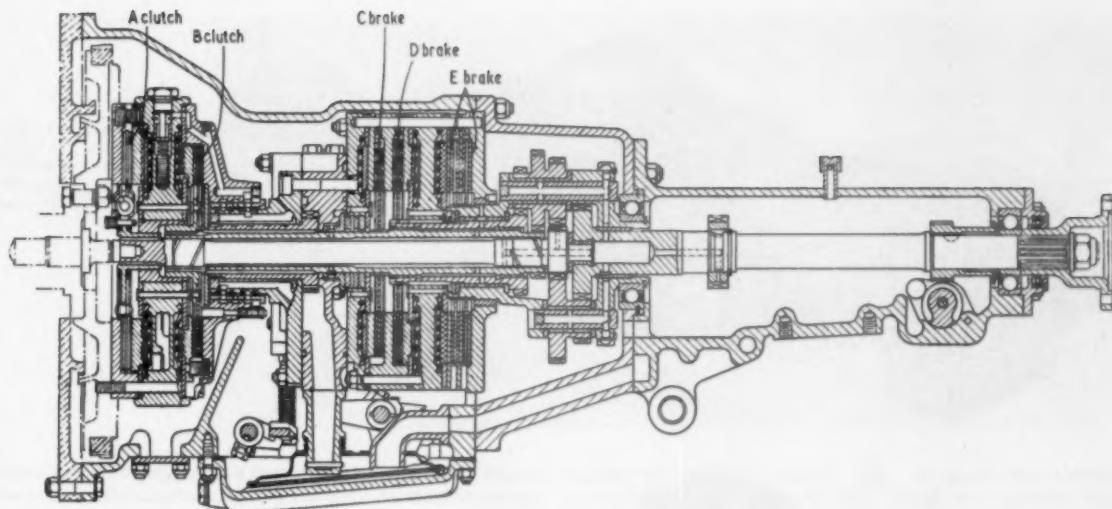


Torque converters, as well as fluid couplings are in regular production for use in conjunction with Wilson type gearboxes. The two illustrations on the left are of a torque converter and a fluid coupling designed and manufactured by Self Changing Gears Ltd., Coventry



Below: David Brown 2AO two-speed epicyclic auxiliary gearbox designed for use with engines with torque outputs of up to 350 lb-ft. This is the underdrive type: an overdrive version of this unit is also available





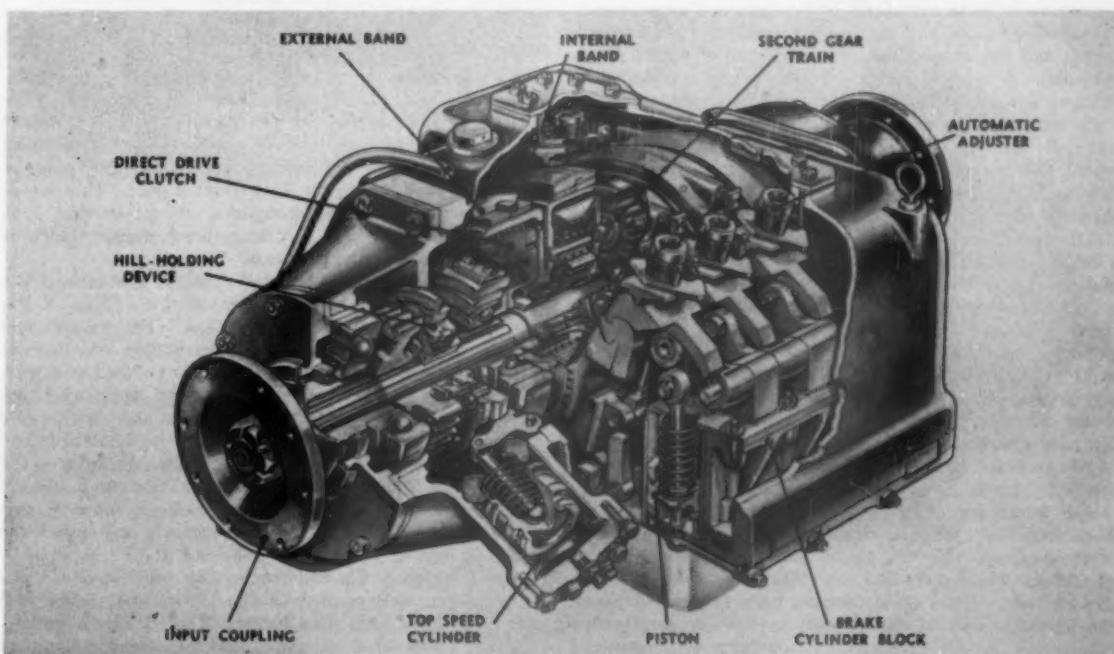
Longitudinal section of the Hobbs Mecha-Matic transmission, showing the arrangement of the hydraulically actuated multi-plate friction clutches

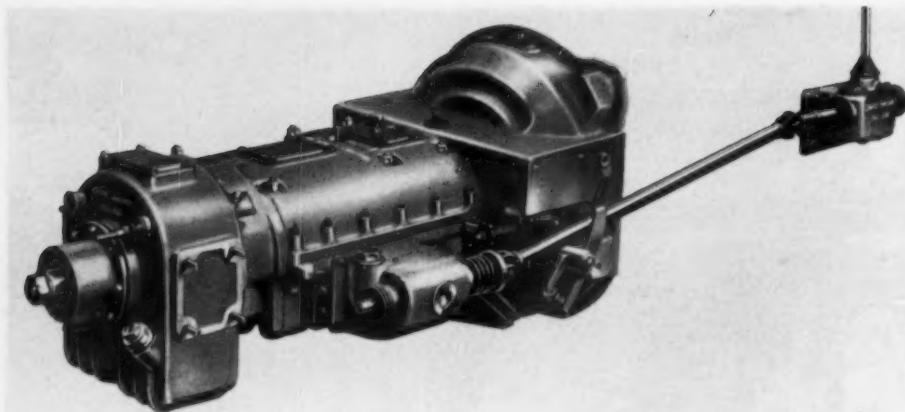
Ltd., on their 7 and 9 ton models, also have a five-speed gearbox with an overdrive sixth speed, the overdrive ratio being 0.76:1. Atkinson Vehicles Ltd., on a number of models, also use a gearbox having five forward speeds, and the direct drive is in top gear. They also exhibited their model DT.1366CA six-wheel chassis, in which the gearbox has six forward speeds and one reverse, the top gear again being direct. The five-speed gearbox shown by Dodge has helical gears for third and fourth speeds, and provides direct drive on the latter. Gearboxes having five speeds are also shown on a number of other makes of vehicle, such as E.R.F. Ltd., Guy Motors Ltd., Maudslay Motor Co. Ltd., and Leyland Motors Ltd. Among the other makes of five-speed gearbox, is the Fuller range. Gear change controls,

of either the direct or remote control types, are provided with these gearboxes.

On the heavier type of truck, it is becoming quite common practice to provide more than four speeds, a number having gearboxes with five or six speeds. This is done so that engines of reasonable output can be used and still provide adequate performance under a wide variety of road and traffic conditions. Multi-speed gearboxes of this type can be produced at reasonable cost, whereas automatic transmissions giving equivalent ratios or performance would be complicated and expensive. Therefore, it is apparent that manually operated gearboxes, with the normal type of clutch and controls, will continue to be used on heavy commercial vehicles for some considerable time to come.

This four-speed epicyclic gearbox of the Wilson type, the brake bands of which are pneumatically actuated, is manufactured by Self Changing Gears Ltd.





The David Brown 557A five-speed gearbox, which has an auxiliary two-speed epicyclic box mounted on its rear end



Arrangement of the rotating elements of the David Brown 561 gearbox

For special purpose vehicles such as the Atkinson, E.R.F., Foden, Unipower and Thornycroft heavy tractors, special transmissions giving a large number of ratios are required. Obviously, all these transmissions are exceptional and are designed primarily to cope with the large torque output of the engines, and to deal with the varied and arduous operating conditions of these vehicles. The Atkinson Omega tractor has all-wheel-drive, and the gearbox itself has eight forward speeds and two reverse, an overdrive ratio of 0.68:1 being provided. A heavy-duty, two-speed transfer and auxiliary gearbox is used. It gives direct drive or a ratio of 1.6:1, with full torque power take-off and fully-automatic front-wheel-drive selection. The E.R.F. model 66GSF, six-wheel tractor has a 16 in diameter single-plate clutch, driving a constant mesh overdrive gearbox, which has ten forward speeds.

There are three vehicles, manufactured by Fodens Ltd., with a twelve-speed double-underdrive gearbox. The Unipower Hannibal, manufactured by Universal Power Drives Ltd., is a four-wheel-drive timber tractor. It has a five-speed primary box, with a two-speed auxiliary box, to divide the drive between the front and rear axles. This arrangement gives a total of ten forward speeds and two reverse. A power take-off is also provided. On the Thornycroft Antar chassis, a four-speed main gearbox is used in conjunction with a three-speed auxiliary box, both of which are of the constant mesh type. Together, they provide twelve forward speeds.

An interesting transmission damper was shown by Metalastik Ltd. Its inner ring is bolted to the output flange of the gearbox. This ring carries bonded rubber mountings, or springs, which carry and centralize an outer inertia type, damper ring. There are no moving parts to wear, and once the characteristics of the rubber springs are set, further adjustment is not required. It obviates an undamped

critical speed and introduces two well damped critical speeds, one above and the other below the speed at which resonance would otherwise occur. This damper prevents noise being caused by hammering of the gear teeth, which may occur at certain critical speeds, dependent on the design and type of vehicle.

For the location of components, such as bearings, in their housings and on shafts, a simple retaining ring, named Spirolox, is offered by Wellworthy Ltd. This ring is made in the form of approximately two turns of a flattened steel wire, so there is no gap when it is fitted. The retainer is a useful alternative to the normal type of circlip or spring-ring.

#### Overdrives

This term is now being applied to gearboxes where the top gear is not the direct drive, but is geared up. An automatic overdrive is still offered, as optional equipment, by Borg-Warner Ltd. It is applied at the rear end of medium-size, car type gearboxes. The gear changing on this overdrive is operated in much the same way as on automatic transmissions, and the only control that the driver has, or really needs, is in the form of a kick-down switch, operated by the accelerator pedal.

#### Automatic transmissions

Apart from the use of this type of transmission on public service vehicles and coaches, there is interest in their adoption for the smaller type of commercial vehicles, for the carrying of either passengers or goods. A most interesting exhibit was the new Austin taxi, which has been approved recently for use within the Metropolitan area. This taxi is entirely new in design, throughout, except in that it is powered by the B.M.C. 2.2 litre diesel engine, which is used in the current London taxis.

Coupled with this engine, and fitted as standard, is the Borg-Warner, fully-automatic transmission. This is the first application of its kind in England. The transmission gives a smoother take-up of the drive than did the old transmission, and thus increases the comfort of the passengers, as well as of the driver. For service in congested cities, such as London, the freedom from continual clutch pedal and gear lever operation should prove to be a safety factor, and allow the driver a greater degree of concentration on the heavy traffic. The cost of such a transmission can be readily absorbed with a vehicle of this kind owing to the very large mileage that is covered between overhauls and before the useful life of the vehicle comes to an end.

Designed for similar and even smaller vehicles, the Hobbs transmission, now termed Mecha-Matic, was shown in a more advanced form than before. This design is entirely different from that of the automatic transmissions of

*The mechanical efficiency of the Hobbs Mecha-Matic transmission is high because it has no torque converter*



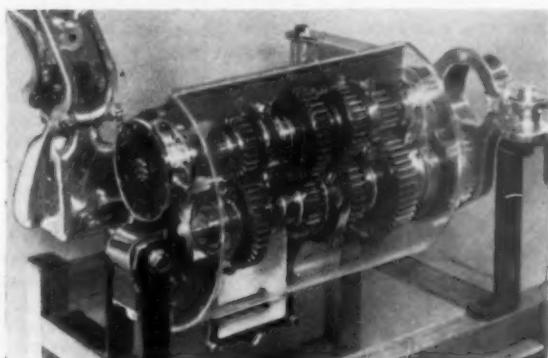
transatlantic origin, since it has no fluid coupling or torque converter, and thus avoids the losses inherent in these devices. Hobbs use hydraulically operated friction clutches both for starting the vehicle and for all gear changing. The gearing is of the planetary type, and there is no loss of power during gear change. Four forward speeds and one reverse are provided. The efficiency of the unit should be such that it could be applied to small delivery vans and pick-ups.

Control is effected by means of a simple lever, which can be placed either in the 'automatic' drive position, or can be moved to 'hold' any of the lower gears. The automatic change-up is reassuringly smooth, as also is the clutch

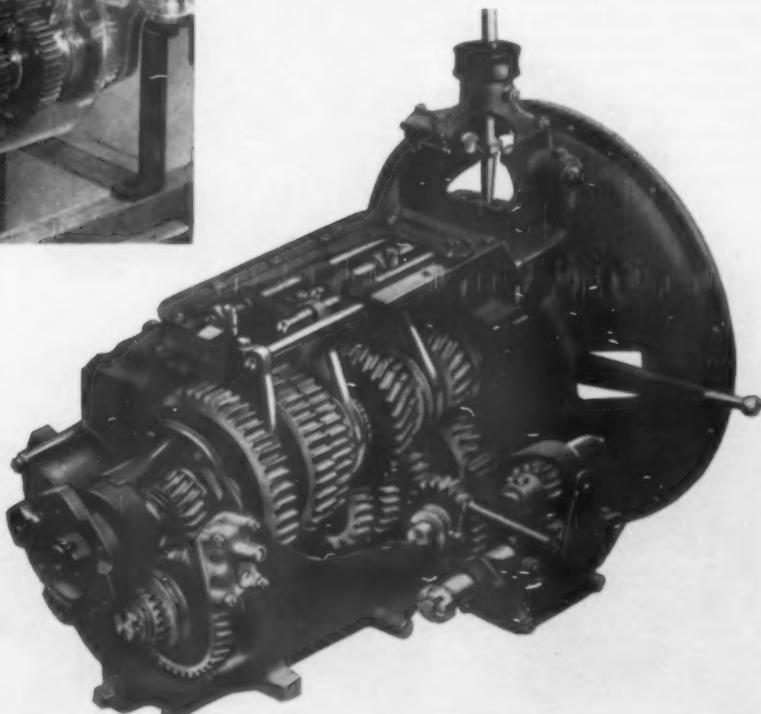
engagement from a standing start. A point not always appreciated is that the automatic change down causes the engine to act as a brake, and thus in heavy traffic it facilitates driving, and avoids some use of the brakes.

Hobbs also have a similar transmission in larger sizes suitable for public service vehicles. Their public service vehicle type units are self-contained and compact, having input and output shafts at each end. They can be installed under the floor of a bus or coach, the principle of operation being similar to that of the smaller sizes.

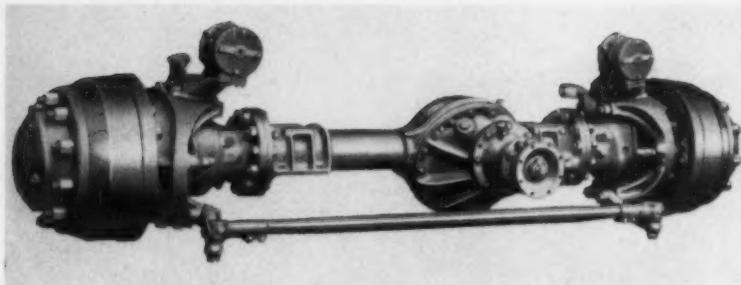
A transmission of quite a different type is the Hydromedia, made by Zahnradfabrik Friedrichshafen A.G., which has a torque converter coupled with a two-speed constant mesh



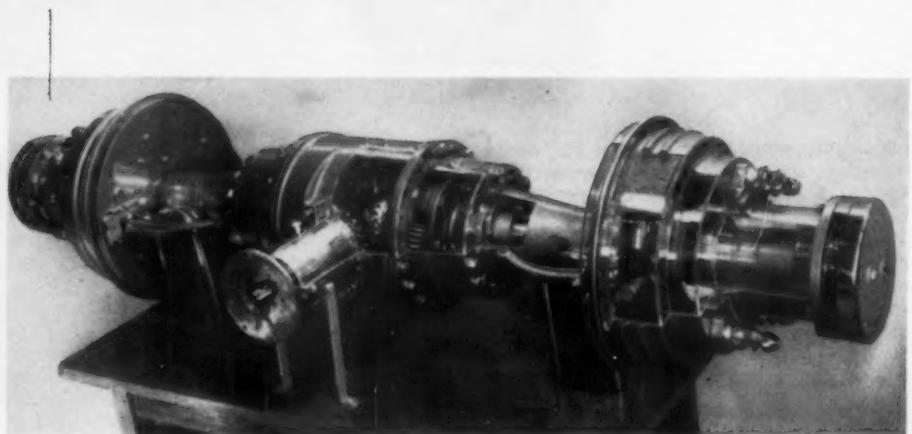
*Left: This six-speed heavy duty gearbox, equipped with overdrive, is used on the Scammell Highwayman, Mountaineer and Constructor range of vehicles. All the gears except reverse have sliding dog engagement*



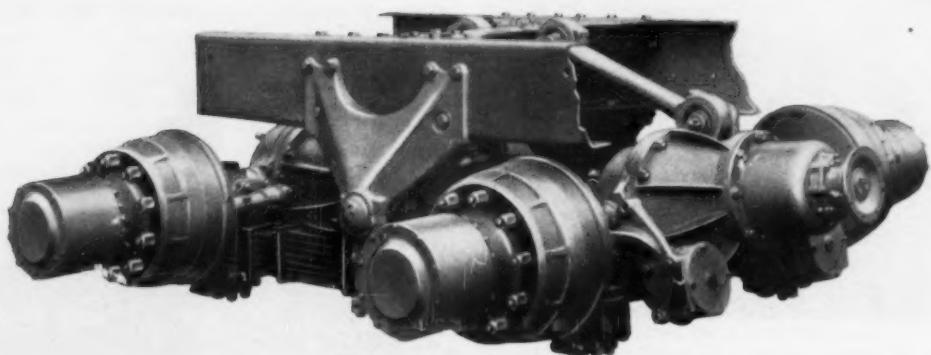
*Right: The new range of Leyland Super Comet 9 ton trucks is equipped with this five-speed gearbox, which has a built-in overdrive. Case hardened nickel-chrome steel is used for all gears*



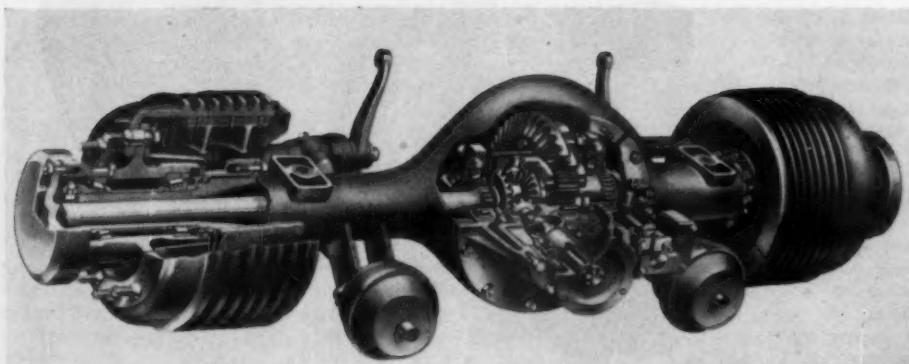
The Kirkstall, driven front axle is a good example of this type of design: it has robust king pin bearings and universal joints, all of which are well sealed



Scammell heavy duty axle with spiral bevel and epicyclic reduction gears. The casing has a cast steel central component, with a forged annulus



Above: The Kirkstall, 24 ton, double-drive, hypoid twin-axle bogie



Left: Electrically controlled two-speed axle offered by Leyland as an alternative to the new hub reduction axle on their Super Comet range

gearbox. Gear changing is accomplished by means of hydraulically operated plate clutches and, if desired, all changes of gear are fully automatic. Alternatively, lever or push-button controls can also be provided. The torque converter operates only in the first and reverse gears, and the second gear can be directly coupled to the engine shaft, so that all converter losses are avoided when the transmission is in second and third speed gears. For operation in hilly country, the number of ratios available in this transmission is hardly adequate, and ZF, therefore, offer an additional model, giving three speeds plus the torque converter.

On the larger vehicles, there are a number of examples of the fluid coupling, or the torque converter, used in conjunction with the Wilson epicyclic gearbox. Transmissions of this type are offered by Self-Changing Gears Ltd., and they have been a standard feature of many public service vehicles for some time, and are used on a few luxury cars.

C.A.V. Ltd. have developed their fully-automatic electrical gear-shift control equipment for use with the type of transmission system mentioned in the previous paragraph. It greatly eases the task of the driver in heavy traffic, while also providing greater passenger comfort, by virtue of smoother starting and smoother gear changing. A full description of this control was given in the February 1957 issue of *Automobile Engineer*.

An interesting form of free-wheel, for use in transmissions, is the sprag clutch shown by Renold Chains Ltd. This clutch has steel segments, or wedges, in an annular space between concentric inner and outer races. An expanding coil spring actuates the sprags, exerting a slight tilting force on each of them and keeping them in light contact with both the inner and the outer race. Thus, there is no lost motion and, on reversal, the driving torque is instantaneously transmitted from one race through the sprags to the other.

## Final Drive Units

### *Fewer Worm Drive Units, and New Two-Speed and Third Differential Arrangements*

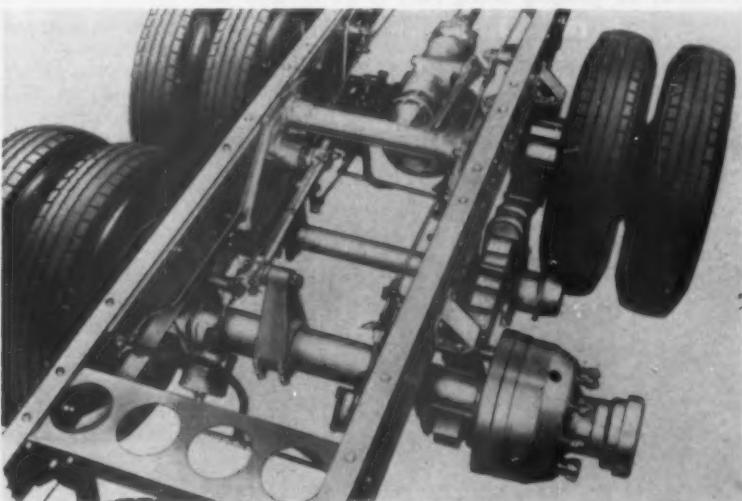
**A**MONG the tractors, the Atkinson Omega and the Unipower Hannibal have both the front and rear wheels driven. Front-wheel-drive axles were also shown by Kirkstall Forge Engineering Ltd.; one of these exhibits was a unit of 7½-ton capacity. High transmission efficiency, it is claimed, is obtained by the use of double-reduction gearing, with a spiral bevel at the centre of the axle and a secondary reduction, by means of concentric spur gears, in each wheel hub. This permits the use of a bevel pinion with fourteen teeth and a ratio of only 2·4 : 1, thus giving long life and rendering gear failures unlikely. The drive shafts are relatively lightly loaded, as also are the universal joints. An overall axle ratio of 7·5 : 1 has been adopted. The hub gears have triple planet pinions and internal annulus gears, an arrangement that gives low tooth pressures. The use of the large bevel pinion and the small diameter crown wheel enables a small housing to be used, thus giving unusually good ground clearance.

For special or severe operating conditions, particularly where the vehicles have to operate over rough country, there are great advantages to being able to drive all the vehicle road-wheels. However, as the front driving axle also has steering duties to perform, the king pin bearings and universal joints at the king pin must be particularly robust

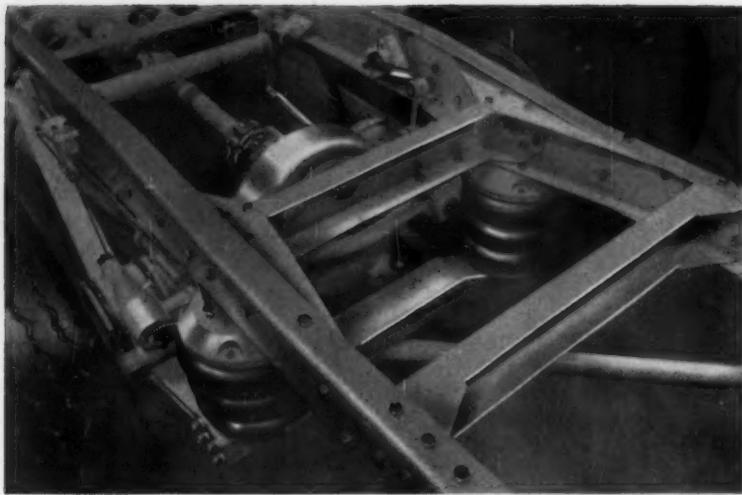
and well sealed. The Kirkstall axle is a good example of this type of design.

Although worm drive axles are still used, spiral bevel types are becoming more popular for the heavier vehicles. Hypoid type axles are now widely used on the small and medium vehicles. It is interesting to note that on the new Austin taxi, the worm drive has been abandoned, and this vehicle incorporates a hypoid rear axle, with three-quarter-floating axle shafts. Because of the pinion offset, there is a slight rise at the centre of the rear part of the body floor, but it is not enough to cause any inconvenience to the passengers. The driving and overrun efficiency are increased, as compared with the old type axle, and it should also be more silent.

On the smaller types of vans, standard axles of the hypoid type, identical with those used on cars, are generally adopted, with some slight change in ratio. For the medium to heavy trucks, the large-quantity manufacturers generally produce their own rear axles and, for vehicles up to 5-ton payload, these are generally of the spiral bevel type. On the trucks of



*On the Leyland Octopus van exhibited at the Show, the normal second driven axle is replaced by a trailing axle, to reduce the chassis weight by 4½ cwt. The layout is the same as that of the double-driven rear bogie, and many of the components are common*



Left: On the A.E.C. Reliance rear suspension, the air springs are mounted behind the axle

Front axle layout of the A.E.C. Reliance, showing the connection of the panhard rod just forward of the air-spring seat



7 ton and upwards, a very wide variety of types and makes of axle is used, the design being determined by the general layout and type of vehicle, and the use to which it is to be put. It is obvious that heavy dumper and timber-hauling tractors need very special treatment in their driving units, and this particularly applies to rear axles. The following different types of rear axle were employed on vehicles of this kind exhibited at Earls Court:

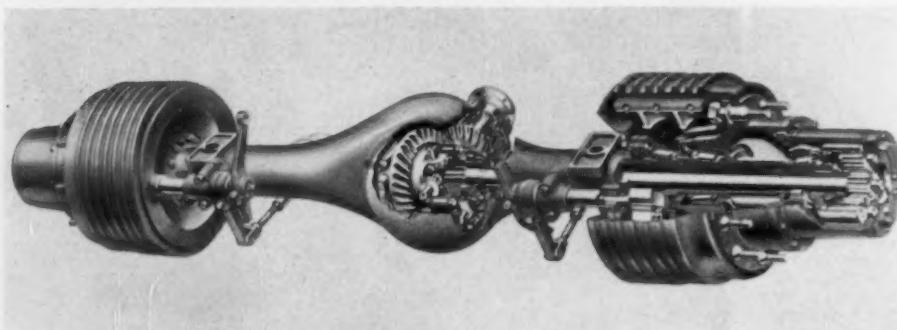
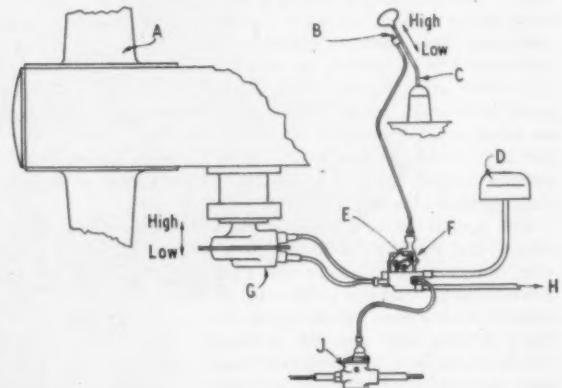
Fully-floating spiral bevel  
 Fully-floating hypoid  
 Underslung worm drive  
 Double-reduction spiral bevel and spur gear  
 Double-reduction hypoid and hub gear  
 Two-speed fully-floating spiral bevel  
 Two-speed fully-floating hypoid  
 Overhead worm drive rear axle, for dual-drive  
 Overhead worm drive and hub reduction

Some firms use two or more different types of axle in their range of vehicles, and there does not seem to be in every instance any particular reason for this, except possibly that some of the applications are on older designs of vehicles. Considering the moderate quantities involved in the sales of commercial vehicles carrying over 7 ton, it would appear that the multiplicity of designs, spare parts, production and tooling cannot be desirable from the point of view of economics. However, the grouping taking place in the industry may give some scope for more rationalization and standardization of these units in the future.

Eaton Axles Ltd. for a long time, have made a speciality of two-speed rear axles, and they use an electric control for gear shifting, the high ratio being the direct one. This

Compact vacuum actuated two-speed axle control manufactured by the Lockheed Hydraulic Brake Co. Ltd., of Leamington Spa

A rear axle assembly; B operating button; C gear lever; D air cleaner; E cable trunnion screw; F control valve; G axle shift servo; H pipe to reservoir or intake manifold; J speedometer drive ratio change



By the employment of hub reduction gears on the new Super Comet range, Leyland Motors Ltd. have minimized the weight and increased the strength and durability of this final drive unit

manufacturer also produces tandem rear axles that have a third differential mounted in the gear case of the forward driving axle.

Kirkstall showed three main types, these being a worm drive rear axle of 9 ton capacity, a double-reduction rear axle of similar capacity, with spiral bevel and helical gears, and also a double-drive hypoid bogie of 24 ton capacity. In the latter, the primary reduction is by hypoid bevel gears, with secondary planetary gears in the hubs. The offset of the hypoid pinion from the wheel axis enables a straight-through drive to be taken to the rearmost axle, as is the common practice with worm gearing. A third differential is fitted, and is equipped with an air operated differential lock, of the multi-plate disc type. This type of lock ensures positive and immediate disengagement, thus obviating any difficulty due to wind-up between the axles. A special

feature of the Kirkstall axle is the use of a one-piece axle forging, in the manufacture of which this firm specializes.

Moss Gear Co. Ltd. showed banjo type, rear axles, ranging from 3 to 10 ton capacity, and it is interesting to note that only the smallest axle, a 3 ton unit, has hypoid gears. The others, having capacities of 6, 7 and 10 ton, all have spiral bevel gears: no doubt this is done in the interests of efficiency.

There is a variety of controls for rear axles of the two-speed type. Lockheed Hydraulic Brake Co. Ltd. now have a new arrangement, with push-button operation. It comprises a vacuum valve, which is selected by a push-button on the gear lever, to operate the vacuum actuated diaphragm of the shift servo. The power source for the vacuum operation is from the induction manifold on petrol engines or an exhauster on diesel engines. Provision is made for automatic changing of the speedometer drive ratio with the axle ratio.

## Suspension and Steering

*Air Suspension Attracting Much Attention and Some Transverse Leaf Spring Front Suspension Systems Introduced for Light Commercial Vehicles*

IN the light commercial vehicle class, several new vehicles each with independent front suspension and two with independent rear suspension, were exhibited this year at Earls Court. For the heavier classes of vehicles, especially the public service types, air suspension is being given a lot of thought. Two complete four-wheel coach chassis on view had air springs for each axle. Although still in the development stage, they are nevertheless a pointer to the future shape of designs; but whether all designers are of the same mind is far from clear. There appears to have been no serious attempt yet to produce mechanical springs having air suspension characteristics, and including the very important levelling devices. This might possibly be done by the combination of laminated or coil springs with rubber. There is no doubt that the ordinary laminated spring has many desirable features in addition to providing axle location. It cushions all the forces transmitted through the axle, whether they arrive from the propeller shaft, brakes or road wheels. Air springs, like coil springs, are not capable of performing any function other than springing, that is, they have to be used in conjunction with wheel location links. If beams are used to replace the laminated springs, for axle location, the resultant structure is normally free to move only in a vertical plane. This might lead to harshness of the ride in the vehicle over certain road surfaces. Although rubber joints and mountings are being increasingly used, their cost has to be seriously considered.

The size of the air springs is determined entirely by the weight carried, since the air pressures in the units are in the order of 70-75 lb/in<sup>2</sup> for a fully laden vehicle. For this reason, vehicle designers generally employ a layout with the air springs on levers arranged to give an appropriate mechanical advantage so that the size of the bellows is kept to a minimum. In some installations, however, where it is not possible to arrange for a leverage, the springs are used in pairs.

Two double-deck buses have air springs on the rear axle only. They are L.T.E. Park Royal Routemaster and the A.E.C. Bridgemaster, which appear to have almost identical suspension components. Air suspension is being used in increasing numbers for trailers. The Dyson 15-17 ton semi-trailer, with tandem axles and long, two-convolution air bellows springs of André manufacture, was exhibited two

years ago. Because of its success, a new 8 ton light-weight trailer with air suspension has now been produced.

Reliant Engineering Co. (Tamworth) Ltd. have redesigned the front suspension of their three-wheel 5 cwt van and, to satisfy overseas demand, have produced the 10 cwt Regent Four, which has four wheels. The rear suspension of the larger model is similar to that of the three-wheel vehicle, which has been in production for a number of years. Narrow laminated springs, controlled by direct-acting telescopic dampers, are employed. On the smaller vehicle, the front wheel is mounted on a forward-extended swinging arm pivoted in rubber bushes. The arm is fabricated from channel section pressings welded together to form a box member. This member and its corner, or gusset, bracing are welded to a tubular pivot shaft. The whole assembly, with its widely spaced bearings, gives adequate rigidity. Collars locate the split, shouldered, rubber pivot bearings, which are secured to the chassis cross-member by bolted-on bearing caps.

*On the Reliant, 5 cwt, three-wheel van, the front wheel is carried on a swinging arm, and the suspension spring is housed in the damper unit*



A direct-acting telescopic damper and spring unit supports the wheel load, which is anchored at its lower end on brackets close to the king pin, and at the top on a forward rising sub-frame. The king pin is pivoted in plain bushes used in conjunction with thrust washers. It is housed in the brake so that the axis of the pin is in line with the centre of the road wheel, thus eliminating any self steering tendency of the wheel. In the normal static laden position there is  $1\frac{1}{2}$  deg positive castor.

The steering linkage has had to be redesigned to suit the new suspension layout. A Burman steering unit is bolted to a sub-frame and, in the static laden condition of the vehicle, the ball-joint on the end of the long drop arm is approximately in line with the centre of the swinging arm of the suspension. For perfect geometry, this ball-joint should be positioned in line with the pivot of the swinging arm, but the makers claim that, with the normal road wheel movement, there is no noticeable steering effect. A turning circle of 28 ft has been obtained.

The larger model has a 9 in longer wheelbase and a turning circle of 30 ft. Independent front suspension is employed. It is of the unequal length wishbone type, with coil springs and telescopic dampers. These dampers pass through the centre of the spring and their upper ends are carried in a turret pressing. Provision is made for camber and castor adjustment, by the use of shims between the wishbone inner pivots and the chassis cross-member. To limit costs, the majority of the components used in this suspension are the same as those used on a current well-known British small car.

A Burman steering unit is used on the four-wheel model and the three-piece steering tie rod, which passes through the front frame cross-member, is almost in a straight line. The steering unit and idler bracket mountings are interchangeable, to suit left- or right-hand drive.

Just prior to the exhibition The Standard Motor Co. Ltd. announced two forward-control vehicles with common chassis components. They are the 12 cwt Atlas van and pick-up, which have a completely new front suspension. In some respects this suspension resembles those on the immediate pre- and post-war vehicles. It is obvious that the aim has been at the employment of as many components currently in production as possible, and a sound substantial design has been the result. A transverse spring of laminated type forms the lower links and is used in conjunction with wishbones, which are pivoted on nylon bushes and form the upper links. The outer wishbone bearing on each side and spring eye bushes are of rubber. Wide spacing of the mount-

*On the front suspension of the Standard Atlas, 12 cwt range of vehicles, the attachment of the transverse laminated spring to the chassis is effected by means of rubber bushes in eyes formed on the top blade*



ing of the spring on the chassis enables a soft suspension to be used without any undue tendency for the vehicle to roll. In actual fact the layout used gives 50 per cent greater roll stiffness than a centre-mounted spring layout.

The vertical link, with a screwed lower trunnion forming the lower bush for the king pin, is common to all current Standard products, but in this application, side plates have been added and the wishbone, spring and the lower anchorage of the telescopic damper are attached to them. In place of the usual ball-and-socket upper king pin bearing, a bonded rubber bush is employed; therefore, the only grease points are those for the screwed trunnion.

On certain export models, the hydraulic dampers act as an additional bump stop, but normally they act as stops only in the rebound position. A conventional bump rubber is mounted above the laminated spring, inboard from the eye, to give a rising rate characteristic to the suspension.

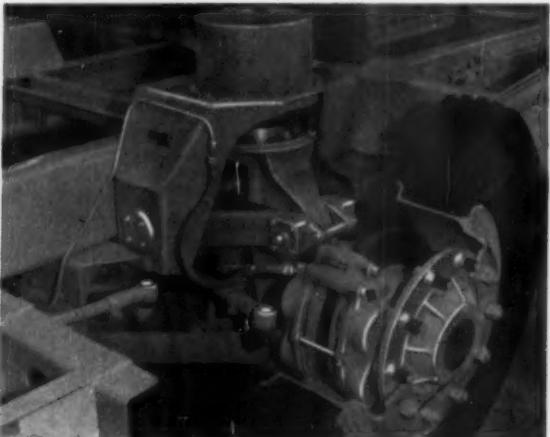
Burman recirculating ball steering gear is employed. It is connected to a bell crank lever by a longitudinal drag link. A three-piece track rod and slave lever assembly complete the connections.

Undoubtedly the smallest and most compact vehicle on view was the Goggomobil 5 cwt van, whose chassis is almost identical to the well-known passenger car of the same make. The only difference is a stiffer rear suspension to cope with the increased loads. Swing-arms are employed for both front and rear suspensions. The front arms comprise tubes, which form a wishbone, pivoted on rubber bushes. Both the front and the rear assemblies incorporate telescopic damper and coil spring assemblies, which are attached to the apices of the wishbones. The front wheels pivot on ball thrust races, which accounts for the exceptionally light steering.

A rack-and-pinion steering unit is bolted to one of the frame cross-members. On the right-hand drive model exhibited, the rack protrudes from the housing at only the left-hand end, to which both track rods are connected. This whole assembly is reversed and repositioned if left-hand drive is required. The top of the steering column is supported on the facia. A grommet type rubber bush, with an oil-soaked felt ring housed in a moulded channel, provides an adequate bearing. There are only  $2\frac{1}{2}$  turns of the steering wheel from lock-to-lock.

Another completely new vehicle is the Jensen 25 cwt chassis, which has independent suspension for all four wheels. The front suspension comprises a 19-blade, transverse laminated spring, and lower wishbones. Since this

*On the Guy Victory chassis, an independent front-wheel suspension system is employed, in conjunction with an air spring. The spring is of the rolling diaphragm type and is mounted on top of the vertical link*



vehicle has front wheel drive, the spring is centrally clamped to a curved cross-member that bridges the transmission case. The upper and lower vertical link attachments are ball-and-socket joints, on which the road wheels pivot. A stamping of substantial proportions forms the upper ball-socket, and it is bolted to the spring master blade. As with the Standard Atlas chassis, the bump rubber is set well inboard to give a very desirable rising rate characteristic. The makers claim that dampers are not necessary, but experience may prove otherwise, especially under wet conditions, when the spring will have very little inherent frictional damping.

At the rear the tubular swing axles pivot on rubber bushes. Welded to each tube are pendant pressings that form platforms on which the two coil springs seat. Also attached to these pressings are the telescopic dampers and radius rods.

#### Public service vehicles

A new Guy passenger vehicle chassis known as the Victory has been designed, and is now being developed primarily for the export market. Air springs are employed and levelling is carried out for each of the four wheels. Independent front suspension of the unequal length wishbone type has been adopted, the wishbones being malleable castings.

The vertical link, also a malleable casting, is connected to the outer ends of the wishbones. It houses the king pin bushes and is extended upwards into the spring unit; thus, the spring is direct-acting and there is no leverage ratio. A 3 in bump and rebound travel is allowed, and the lengths and pivot positions of the wishbones are arranged so that wheel camber variation is only  $\frac{1}{2}$  deg from bump to rebound.

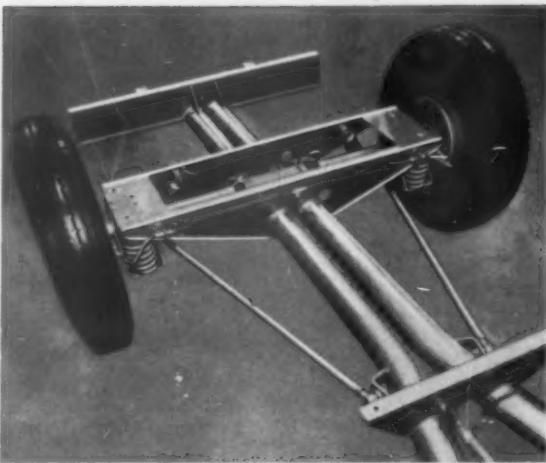
Firestone diaphragm type air springs are employed and the levelling valve arm is connected to the lower wishbone, midway along its length. The outer rim of the diaphragm is secured in a top hat pressing of sufficient volume to give the desired wheel rate. This pressing is bolted to a hood-shape bracket attached to the outer face of the chassis side channels. The vertical link has a flat top, on which the air spring plunger is bolted and a small lug, protruding from the platform, forms the seat for the bump rubber. Metalastik preloaded conical bushes form the bearings for all the wishbone pivots. The Vandervell bushes for the king pin, and the taper roller thrust bearings, which incidentally are preloaded, are lubricated through a simple grease nipple on the top bearing.

The rear axle is secured to the centre of two longitudinal beams one at each side. Seated on the ends of these beams are the air springs. Combined torque and locating rods are attached to each side of the axle, and the two panhard rods are connected near the ends of one of the longitudinal beams. Telescopic dampers are connected to the beams, adjacent to the axle casing, and rubber bushes are used for all suspension pivots. The makers claim that by dispensing with laminated springs, they have effected a considerable saving in unsprung weight.

This soft suspension gives periodicities of 70 c/min at the front and 80 c/min at the rear. These values are substantially maintained irrespective of the load carried. Since these periodicities are comparable with those of passenger car suspensions, it seems likely that further development will prove the need for an anti-roll device. Hymatic levelling valves are employed, and they are regulated to give a 7 sec delay.

A conventional steering arrangement for independent suspension has been adopted. Outer tie rods connect the steering levers to the slave lever and to a bell crank lever which, in turn, is attached to the longitudinal drag link. Maintenance is reduced to a minimum by the employment of rubber bushes. Only the pivots in the steering system require attention with a grease gun.

A new A.E.C. Reliance medium-weight passenger vehicle



Swing axles are employed for the independent rear suspension of the Jensen 25 cwt truck. A pair of coil type springs is fitted on each side

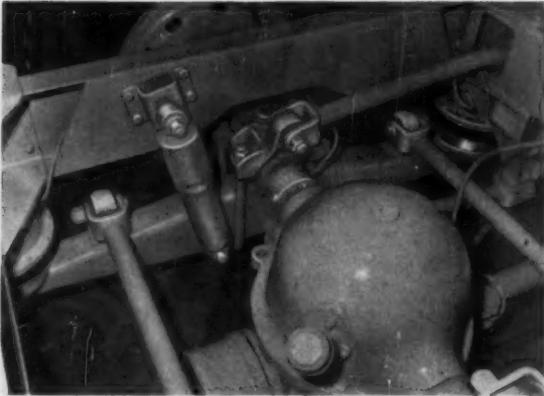


Right, Independent front suspension has been adopted on the Jensen Tempo 25 cwt forward-control truck. It comprises a transverse leaf spring used in conjunction with a lower wishbone arm on each side

chassis has air springs as an optional feature. A conventional axle beam is employed at the front and is located by rigidly attached forward extending torque reaction arms. These arms are pivoted in rubber bushes mounted on the chassis frame side-members. Dunlop bellows type air springs occupy the seats, on the axle beam, that would otherwise carry the laminated spring. The 12 in diameter, three-convolution bellows support the wheel load immediately under the chassis frame.

At the rear, conventional laminated springs are replaced by trailing torque-reaction arms, which are attached to the axle casing by bolts. These arms extend rearwards to form a platform upon which the air bellows are located.

Both the front and the rear axles are located laterally by rubber-jointed panhard rods. Three levelling valves are employed, one in the centre of the front axle beam and one each side of the rear axle. A delayed action of 7 sec has been adopted to prevent the admission or release of air during normal spring movement due to road undulations or while the vehicle is negotiating corners. Air for the suspension is supplied from a supplementary reservoir charged, from the braking system, through a diverter valve. This valve ensures brake operation even in the unlikely event of a failure in the suspension pressure system. Both front and rear bellows are identical and operate at equal pressures when the vehicle is fully laden. This is possible because of the leverage applied by the trailing arms to the rear springs. Irrespective of the loading conditions, the periodicities of



Air springs are mounted on the ends of the beams to which the axle is bolted on the Guy Victory chassis. The tie rod fork-end fittings and the two panhard rods can be seen clearly in this illustration

the sprung weights at the front and rear axles are approximately equal to those for a conventional spring layout when fully laden.

Anti-roll stiffness is obtained at both front and rear axles. Being of open section, the front axle beam has adequate flexibility so far as resistance to the torsional loads imposed by the torque arms is concerned, but owing to the rigidity of the rear axle casing, resistance to roll has to be regulated by the bending flexibility of the torque arms and the limited deflection of the sandwich rubber connections between the arms and the frame. Greasing points have been eliminated on the suspension units and there are only the four on the steering linkage.

An orthodox steering linkage, comprising a longitudinal drag link and a single-piece track rod, is employed. However, since the front axle and the drag link ball-end attached to the steering lever tend to swing in opposing arcs, it would appear that steering of the front wheel occurs with normal wheel movements.

The A.E.C. Bridgemaster double-deck bus has mechanical front and pneumatic rear springs. This vehicle is probably the first bus in service with air as the springing medium. Its chassis consists of two major sub-assemblies bolted to the body framework. The front assembly comprises a short frame, to which engine, radiator, gearbox, front suspension and steering are attached, while the rear assembly incor-

porates all the unsprung components of the suspension.

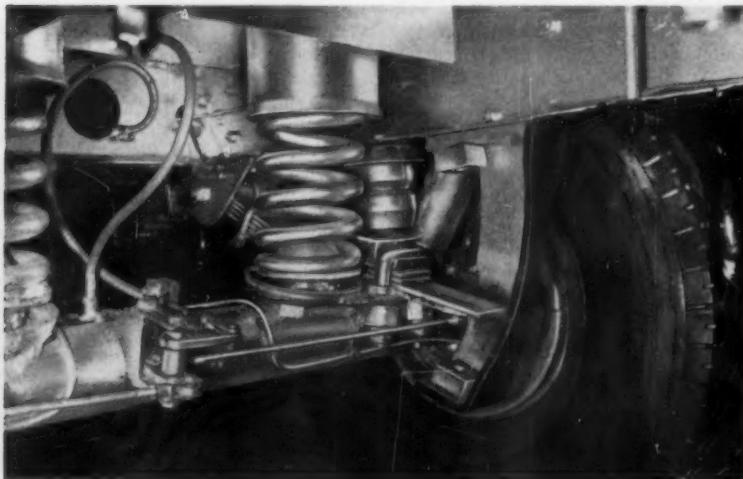
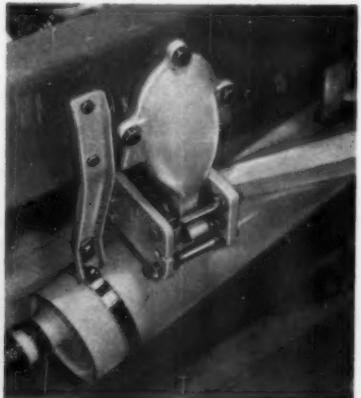
At the front, the suspension is of the unequal length wishbone type, with coil springs. The king pin arrangement is identical to that of a normal beam axle; an I-section vertical link, to which the king pin is secured, is connected to both wishbones. All the pivot bushes are of the conical rubber bonded type. Bolts across each wishbone assembly adjacent to the bearings, preload the rubber. Telescopic dampers are housed inside the coil springs.

At the rear, the axle casing is supported by pairs of inclined sandwich rubber mountings on the radius arms, which are of channel section. These arms are pivoted in rubber bushes at their forward ends and they extend rearwards to join a fabricated transverse beam. The transverse beam carries on its ends an air spring in line with each pair of rear wheels. Rubber bellows of the two-convolution type are employed, and they have what are commonly known as surge tanks fitted above. These tanks are welded to brackets for attachment to the bus structure. Lever arm type dampers are bolted to the transverse beam, and their connecting rods are attached to the bus structure. Levelling valves are attached to the rear of the circular tanks and their connecting rods are secured to the outermost ends of the cross beam. Air is supplied from the braking system, as previously mentioned.

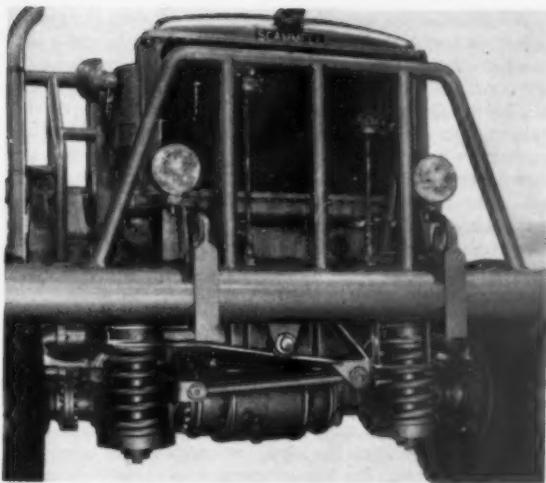
An A.E.C. steering box is used. It is of the worm-and-nut type. Since it is well forward of the front suspension, the drop arm is connected by a longitudinal drag link to a bell crank lever. A slave lever is pivoted on the opposite chassis member, and a three-piece track rod is employed. Maintenance is reduced to a minimum, only the bearings in the steering mechanism requiring lubrication.

Air suspension is incorporated on a single deck 41-seater semi-coach which was exhibited on the Weymann stand. The chassis is known as the Leyland Olympian MK2, and the vehicle is of chassisless construction. Both the front and the rear suspension units are bolted to the body structure. The front axle is mounted on a laminated spring, in the normal manner, and Dunlop, bellows type air springs are housed between each laminated spring and the body under-frame,

On the A.E.C. Reliance, sandwich rubbers are used for the attachment of the rear axle torque arm to the chassis frame



The Primrose third axle attachment for the Guy Warrior chassis incorporates a hydraulic compensator to help to distribute the axle loading



Coil springs and a rocking beam are employed in the suspension of the front driving axle of the Scammell Super Constructor vehicle

rather like a helper spring. This arrangement is very simple and inexpensive. There is a levelling valve on each side, attached to the under-frame. At the rear, the axle is secured rigidly to beams, at the ends of which are the bellows type springs. Torque rods are attached to the forward ends of the beams, and lateral stability is obtained by the use of panhard rods.

#### Heavy-duty vehicles

One of the vehicles exhibited for the first time is the Atkinson Omega heavy-duty tractor, designed for both road and cross-country operation. While capable of hauling trailers of the order of 200 ton gross weight, it is also able to traverse roads at speeds of over 60 m.p.h. This latter requirement has prompted the incorporation of normal road vehicle suspension systems.

A Kirkstall front driving axle is mounted on laminated springs, and the steering linkage comprises a longitudinal drag link, from the steering drop arm to the stub axle lever, and a track rod behind the axle. This particular vehicle is designed for operation on sand, and consequently the wheels are equipped with 21.00-25 sand tyres. Because of these large section tyres, a Woodhead Monroe steering damper is fitted to improve the control. This is a telescopic unit clamped at one end to the track rod and at the other to the axle nose piece. The steering box is of Adamant manufacture and power assistance is provided. For the main driving axles a Kirkstall 24-ton tandem bogie is fitted.

The Scammell Super Constructor, 6x6 vehicle, has a redesigned front suspension, incorporating coil springs and telescopic hydraulic dampers, in place of the pivoted transverse laminated springs. The driving axle unit has a trailing torque arm, which is constructed from twin, channel section beams bolted together at the apex and carried in a bearing on a chassis cross-member. Two arms are bolted to the forward side of the axle to form the coil spring seats. The tops of the springs bear on the ends of a swinging arm centrally pivoted on the front cross-member of the chassis. A panhard rod locates the axle laterally: it is connected to lugs on the swinging arm and to a bracket on the right-hand spring platform. Rubber stops on the swinging arm limit the angular movement between the arm and axle casing, and looped cables suspended from the chassis side-members limit the overall axle movement. Although the axle articulation is not greater than with the previous suspension, the single-rate

coil spring provides a much softer ride. Power-assisted steering is provided, but the system is now hydraulically operated.

#### Minor modifications

In general, several modifications have been made to the suspension and steering systems of a number of vehicles. These are summarized as follows. The A.E.C. Mammoth Major 8 rear suspension now has a redesigned four-spring suspension for the twin axles. The springs are underslung, and the balance beam above the spring eyes is mounted on taper roller bearings. Owing to the greater overhang of the cab on the Albion Chieftain 7 ton vehicle, the flexibility of the front springs has been increased, and hydraulic dampers are a standard fitting. The Dodge 7 ton forward-control vehicle exhibited has redesigned front and rear springs of the dual rate type. Power steering is now a standard fitment on this vehicle, and it is offered as optional extra on all other diesel engine models. To meet the requirements for vehicles to be operated on the new motorways, notably in respect of higher speeds of travel, the Leyland company has chosen a more flexible suspension for both the front and the rear axles on the Super Comet chassis. When the vehicle is laden to the 14 ton gross weight condition, the front and rear springs have a deflection of approximately 4½ in. Telescopic dampers are fitted to the front suspension only. On the Thornycroft Trusty 24 ton gross weight chassis, the Kirkstall bogie has been superseded by a four-spring suspension. The springs are overslung and the balance beam, which has a rubber pivot, is below the spring eyes.

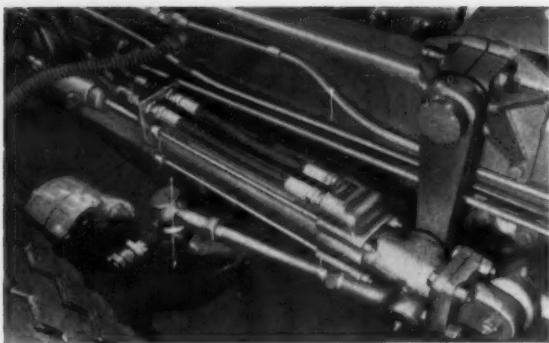
#### Third axle conversions

There is ample evidence that many commercial vehicles are operated regularly in a grossly overloaded condition, and while this practice cannot be recommended, there is little to deter anyone from indulging in this practice. The reduced vehicle performance obtained in these circumstances has apparently been acceptable to the owners, and it is logical, therefore, for vehicle manufacturers to increase the number of axles and announce revised gross tonnage capacities.

Two makes of third axle conversions were exhibited this year, one on a Guy chassis and another on a 7 ton Commer chassis. The Primrose third axle attachment, on the Guy Warrior chassis, is of a particularly interesting design. A second front axle is also fitted to this chassis and the

The rolling diaphragm type air springs on the Hands, 10 ton semi-trailer are mounted on the ends of a transverse beam on an A-frame





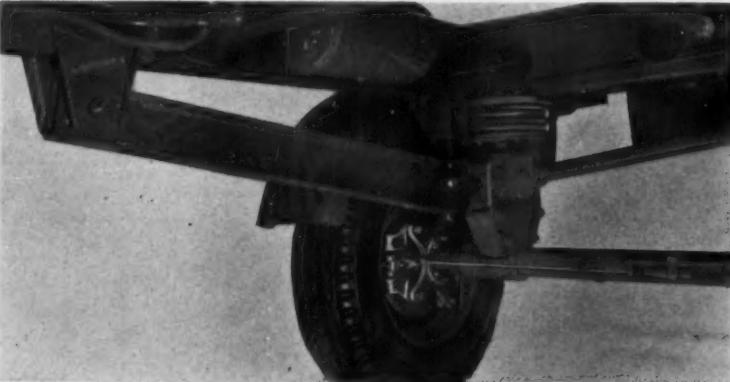
The power-assisted steering installation on the Seddon DD8 chassis

permissible gross weight of the vehicle has been increased from 14 to 24 tons.

T.G.B. Motors Ltd., the Guy distributors in Clitheroe, have formed a new company, named the Primrose Third Axle Co., to manufacture and execute conversions for the third axle attachment. With their design they have attempted to cover all contingencies, and while they themselves carry out vehicle conversions, the third axle can also be purchased in kit form, which includes not only the suspension components but also auxiliary, chassis side-members, to ensure that the complete vehicle is suitable in all respects for carrying the increased payload.

The axle is mounted rigidly on a short, quarter-elliptic laminated spring, which is pivoted, forward of the axle, in rubber bushes on a bracket on the frame side-member. While acting in a limited degree as a spring, the main purpose of this component is axle location. On each side of the chassis, an arc-shape angular bracket, pendant from the frame, carries the bump and rebound rubbers, which act against the ends of the lower two blades of the springs.

To obtain the greatest possible height for the installation of the coil springs, these components are positioned inboard of the laminated springs. The lower end of each spring rests on a spherical seating, and the top end bears against a flanged cup and exerts its force on a hydraulic piston assembly, the function of which is discussed in the next paragraph. The whole of the top assembly is attached to the side of the chassis frame. On the model exhibited, an Aeon rubber spring is positioned between the quarter-elliptic spring and the underside of the chassis frame, immediately above the axle. This supplements the coil spring and provides a rising rate characteristic for the suspension. Large telescopic dampers control axle movement, and it has been found by experiment that very high rebound settings are advantageous.



Left, On the Dyson trailer, which has air suspension on all four wheels, axle location is effected by trailing arms and panhard rods

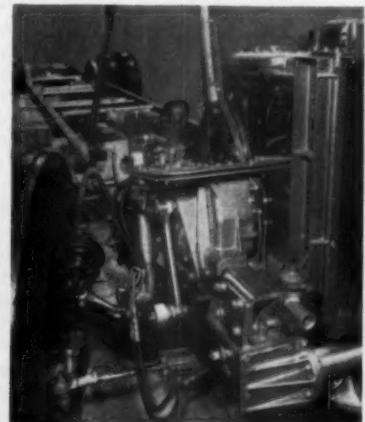
A hydraulic ram assembly is mounted between the chassis side-members and the vehicle's normal rear axle, and a pipe connects this ram to the top of the piston assembly above the third axle. The purpose of this hydraulic system is to ensure at all times that maximum traction is obtained for the driving axle in both accelerating and braking conditions. The fluid operates in a completely closed system: when the driving axle lifts relative to the chassis frame, oil is forced in to the piston and cylinder assembly that forms the upper support of the coil spring, thus compressing the spring and ensuring that it takes its share of the load. The ram is connected to the rear of the driving axle. Therefore, when a forward gear is engaged, as torque is applied by the propeller shaft to the axle, the ram extends and oil is drawn from the cylinder above the coil springs, so that some of the load is taken off the third axle and placed on the driving axle. Under braking conditions, when the vehicle is driving in a forward direction, the action is reversed. This is most desirable because the brakes on the third axle are connected to the main brake system of the vehicle. Practically no maintenance is required on this conversion; the only grease nipples being those on the pivots for the laminated springs.

A Unipower conversion on the Commer 7 ton chassis permits an increase in payload of 3 ton. The third axle fitted to the chassis incorporates a maximum of standard components, but the suspension layout is redesigned to include central balance beams. Four identical springs are employed and they are mounted above the axles. The pivot of the balance beam is eccentrically positioned, so the load carried by the third axle is always less than that on the driving axle. As on the Primrose chassis, the third axle is connected to the vehicle brake system. The conversion has not been designed without due consideration being given to the main chassis frame to ensure sufficient rigidity under the increased payloads. Angle-section runners are bolted to the main frame side-members; this reinforcement extends from the front axle to the rear end of the frame. Additionally, three U-section cross-members are fitted, one to each of the spring anchorage points and the third adjacent to the balance beam pivot.

#### Trailers

In the exhibition, there were three new trailer chassis with air suspension. In cases where provision is made for the trailer to be detached from the motive power unit and

Right, The control valve for the power-assisted steering of the Daimler CVD 650-220 chassis is housed in the drag link



left standing, the reservoir for the air supply to the suspension is housed on the trailer. It is also interesting to record that not all trailers fitted with air suspension have delayed action type levelling valves.

The Dyson 8 ton, four-wheel, light-weight trailer has the same type of suspension for the front and rear axles. Both axles are secured to radius arms pivoted on rubber bushes mounted on the chassis side-members. The arms extend rearwards to form a platform for the air springs, which are of a bellows type. Telescopic dampers are installed just behind the air springs. A panhard rod is attached to a bracket pendant from the chassis.

A semi-trailer, manufactured by Hands (Letchworth) Ltd., having a 10 ton capacity, incorporates a canister type of air spring manufactured by André. A standard axle is used; it is secured to A-shape chassis members, which are pivot mounted, at their apex, on a cross-member. Behind the axle, the transverse beam attached to these members extends to the air spring seats which, to obtain the maximum practicable anti-roll stiffness, are in line with the road wheels. Levelling valves are attached at each side, and the telescopic dampers are situated between the axle and the frame. The motive power unit to which the semi-trailer exhibited was attached was not equipped with a compressed air type braking system; therefore, a pump had to be fitted to feed compressed air to the reservoir that is mounted on the trailer chassis.

A third exhibit with air springs was the Taskers 15 ton Airbeam semi-trailer. Two twin-wheel axle units are pivoted on tubular T-shape beams. The tubes forming the cross of the T are carried in rubber bushes in brackets on a cross-member forward of the axles. Mounted on the rear end of the beam is the air spring canister, and just behind it are two telescopic dampers. Levelling valves are attached to the chassis side-members, just forward of the axle pivot.

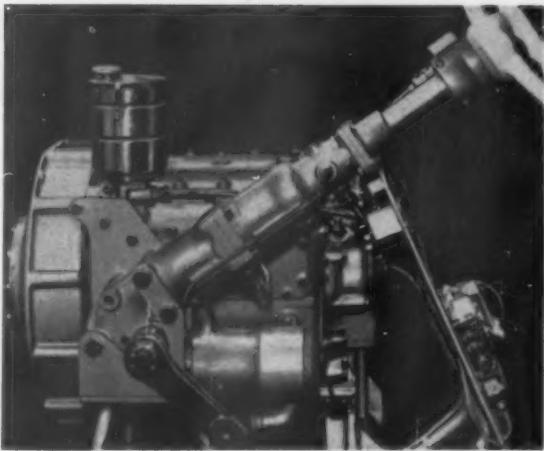
One manufacturer, Eagle Engineering Co. Ltd., exhibited three trailers equipped with air suspension. They were the flat 15 and 16½ ton semi-trailers and a frameless, 3,250 gal tanker semi-trailer. A tandem axle suspension is common to all these types of vehicle, and the design is very simple. Each axle has a triangulated torque reaction arm, which is pivoted on a bracket on a cross-member forward of the axle. At the side, longitudinal beams join the axles. The axle casings are made from tubes, and split circular rubber collars form the connection between the axles and the beams. Interposed between the beams and the chassis side-members are long, air-pillow type springs of the two-convolution type. These are of André manufacture. Rubber bump and rebound stops are fitted, and direct-acting telescopic dampers regulate the axle movement. Levelling valves are connected to the centre of each side beam, and rubber bushes are used throughout, so maintenance is reduced to a minimum. Each axle is completely stable, yet there is provision for sufficient articulation to allow each wheel to conform to the road contour.

### Steering

Few changes in steering layouts are evident on the current range of vehicles exhibited, and those on new chassis have been described in the appropriate sections of the review of individual suspension systems.

There is a definite indication that, in the heavy vehicle class, power-assisted steering is becoming less popular, especially for vehicles destined for the home market. Only a few companies now list power assistance as optional equipment on vehicles of less than 7 ton capacity and even on the heavier range they are not fitted as a standard item. Since practically all heavy vehicles are built specially to order, it is evident that the transport concerns apparently do not yet consider the increased cost incurred is justified.

There is a very wide variety of power-assisted steering avail-



Compactness is a feature of the ZF Spindle Hydro-steering unit

able and with one exception, they are all of the hydraulic type. Generally, it is more convenient to use air since this is available for brake application, but the large size of ram unit necessary to provide sufficient force from an air supply pressure of approximately 80 lb/in<sup>2</sup> inevitably gives rise to problems of installation. The normal operating pressure in the hydraulic units is approximately 1,000 lb/in<sup>2</sup>. As with most items offered as optional equipment, it is most desirable to arrange for their incorporation with the minimum of modification to existing units, and it is for this reason that in practically all instances the ram units are connected to the drop arm or an idler lever in the steering mechanism. The general practice is not to alter the ratio of the gears when power steering is available; therefore, while the force needed at the steering wheel is considerably reduced, the driver could still control the vehicle should the power supply fail. A typical arrangement is illustrated on the Seddon DD8 chassis. In some applications, the control valve is in the end of the operating cylinder, and is actuated by the ball attached to the slave lever, as on the Seddon vehicle. Alternatively, it sometimes is housed either above or below the steering box, in which case the rotation of the steering column moves the valves.

On the Daimler CVD 650-220 passenger chassis, power steering is offered as optional. In this instance, the control valves are housed in the steering drag link. The ram cylinder is attached to the front axle beam, and the rod is connected to a forward extension of the steering lever. This is considered to be the best position for such a unit, as it relieves most of the linkage of the high loads imposed. Also, the ram acts as a substantial damper, and direct attachment to the steering lever is desirable.

In Continental countries far more use is made of power steering than here, and since a number of German vehicle manufacturers fit systems of this type as standard equipment, a completely built-in unit is for them the obvious solution. This has been accomplished by Zahnradfabrik Friedrichshafen, in their product called the ZF Spindle Hydro-steering unit. A medium size unit was exhibited and it is understood that even with import duties its price is competitive. This mechanism is basically a single lead screw and nut, which is attached at its lower end by a connecting rod to a crank on the drop arm shaft. The control valves are actuated by rotation of the steering column, and the nut is housed in the casing to form a double-acting piston. Oil is supplied from a Hobourn Eaton pump driven by the engine. If convenient, the reservoir, which contains a paper filter cartridge, is mounted close to this hydraulic pump.

# BRAKES

*Braking Performance Improved Because of Increased Engine Power, Vehicle Loads and Speeds;  
More Promising Outlook for Disc Brakes*

**S**INCE the previous commercial vehicle exhibition, the design and performance of both drum and disc brakes have been concurrently improved, as though their co-existence is expected to be long continued. Designers of both types are faced with the same overall problem, presented by the need for greater efficiency owing to the trend towards increased engine power and higher speeds, particularly for the heavier types of vehicle, and the restrictive effect of the dimensional limitations that must be observed.

In many instances, drum brake performance has been improved by increasing shoe and lining widths, and there is evidence of increasing preference for moulded instead of woven lining materials. To secure greater working efficiency and a constant progressive shoe lift throughout the life of the linings, the use of roller-ended shoes expanded by S-profile cams is more widely favoured. There is also an increasing tendency to improve performance by mounting brake-operating cylinders close to the wheels, with direct application. For greater safety there are indications, too, of a wider recognition of the desirability of adopting the dual-circuit system whereby leakage, causing failure of the brakes on either the front or rear wheels, does not affect the operation of the others.

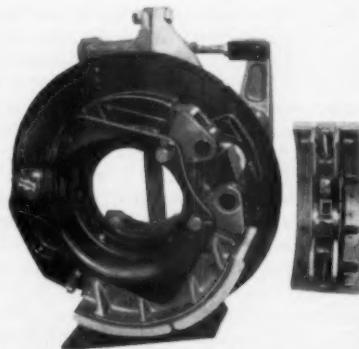
It might perhaps be argued that disc brakes, being mainly proprietary productions, are to some extent at a disadvantage in that they have to be made adaptable to many chassis of different makes, designed to accommodate drum brake equipment. Difficulties, if any, on this account appear, however, to have been successfully overcome, as have the more important defects that service experience has revealed. In a number of instances, increased braking performance for vehicles of large load capacities is obtained by the use of twin-calipers for each disc, and fitting balance tubing to equalize the applied pressures. Discs are also thicker than formerly, with consequent slower temperature rise during prolonged braking.

The number of vehicles exhibited equipped with disc brakes encourages the belief that their wider adoption for heavy trailers as well as powered vehicles in the not too

distant future is more than a possibility. This expectation also appears to be supported by the experience of the Birmingham Midland Motor Omnibus Co. Ltd., whose fleet of about 300 buses have covered over twenty-two million miles with very satisfactory service from their Girling disc brakes. It is stated that the replacement of all the friction pads on a set of bus brakes can be completed in one hour.

Unassisted hydraulic application of the brakes is almost universal for British goods-carrying vehicles up to 3 tons load capacity. The majority above that weight, up to 5 tons, have vacuum-assisted hydraulic equipment, as have also nearly 60 per cent of four wheelers over 5 tons, the remainder in the latter category having either air pressure or air-hydraulic operation. Air pressure alone is used for over 60 per cent of articulated and rigid multi-wheel vehicles, the others having hydraulic brakes operated either by air pressure or vacuum. With few exceptions, large-capacity passenger vehicles have air pressure braking, several with hydraulic final application. Those of medium capacity have vacuum assistance for hydraulic or mechanical application,

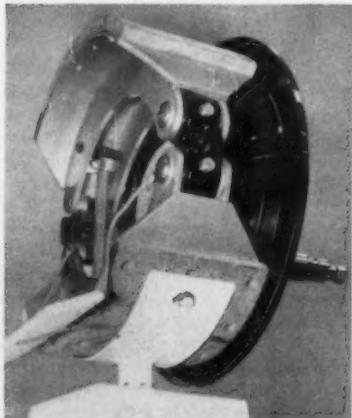
*Lockheed heavy duty camshaft actuated front wheel brake, with one shoe removed to show the spherical ended struts that engage with the adjusters and with the roller carriers*



in the proportion of approximately two to one respectively.

In the designs of some of the latest drum brakes, ease of maintenance has been further considered. This applies, for example, to the new Girling heavy-duty S-cam brakes, which have 15½ in diameter drums with the front shoes 4½ in and rear shoes 7 in wide. The friction linings are ½ in thick. Light-weight twin-webbed shoes of fabricated steel are carried, on a malleable iron back-plate, by chromium plated quick-release anchor pins. The cam acts against rollers which, for passenger vehicles, are mounted on Torrington needle roller bearings and, for goods-carrying vehicles, on interchangeable plain bearings, in both instances at the ends of the shoes. Larger rollers can be fitted to make full use of the linings when worn drums have been rebored. The shoe-retaining springs are formed with a loop at one end to facilitate relieving their tension, for their removal and replacement, by leverage with a tommy bar inserted through a hole in one of the shoes.

The new Lockheed heavy-duty camshaft brakes are designed for vehicles of 14 tons gross weight upwards. Their drums are 15½ in diameter, and range from 4½ in to



*The Girling S-type cam actuated rear brake was exhibited on a display stand*

7 in wide. Fully-floating leading and trailing shoes are expanded by a cam designed to give a constant lift throughout the life of the linings. The camshaft is carried in needle roller bearings by a substantial back-plate, which is separate from the dust shield. Individual external adjustment is provided for the shoes. The cam rollers are mounted on PTFE bearings in carriers pivoted on the back-plate, and, to reduce friction, the carriers bear against spherical-ended struts contained in the shoes. Each shoe is retained in position by a single central bolt and slotted nut that can be turned by an inserted flat key. When the nut is tightened, it compresses a pair of coil retraction springs carried in a steel pressing, so the usual difficulty of removing ordinary pull-off springs is avoided. The design allows brake drums up to  $\frac{1}{2}$  in diameter oversize to be used.

For vehicles up to 10 tons gross weight, the company has produced a new 12 in  $\times$  4 in transmission brake, giving duo-servo performance in both directions of rotation. Operation is by a cable and a scissor-type expander. To reduce friction, the expander is fitted with slotted roller inserts with which the shoe ends are engaged. Single-point adjustment is provided, and a spider-type back-plate assists heat dissipation. A spiral bias spring surrounding the adjuster automatically centralizes the brake in the event of slight unequal wear of the linings. Beyond the limits of this automatic adjustment, it can be centralized by bolt and nut adjustment.

An improved, vacuum actuated triple braking system for synchronized operation on front and rear wheel brakes has been introduced by Clayton Dewandre Co. Ltd. It incorporates a new relay valve and an additional supplementary reservoir connected to the master servo. When the brake pedal is depressed, the relay valve is opened to connect the supplementary reservoir to the front wheel brake operating cylinders, so that the front brakes are applied simultaneously with those on the rear wheels.

Another new Clayton Dewandre product is a hydraulic braking system for medium-weight trucks. It can be operated with either air pressure or vacuum assistance, in each case with the same basic system. For the former the equipment comprises an air compressor and pedal control valve, both pipe-connected to the new Airpak power servo, which has an integral air pressure reservoir, and hydraulic output. For vacuum assistance, an exhauster is used instead of a compressor and, in place of the Airpak, the new reservoir-type Hydrovac is employed. The latter can be used also for other applications, rendering the provision of a separate reservoir unnecessary. An example of this is on a Commer 5 ton vehicle.

The Lockheed range of Hydrovac servos has been extended to include 7½ in single and tandem units and a 9½ in tandem model. Operation of the tandem versions is identical with that of the single type, but with two pistons instead of one and slightly more hydraulic displacement; they give a considerably higher output for a slight increase in input pressure. A tandem Hydrovac is fitted to the Atkinson eight-wheel 24 ton vehicle, as exhibited, and operates the hydraulic brakes on six wheels. It can, however, be applied to the eight wheel brakes if required.

Important advantages are offered by the new flange-mounted exhauster, which, it is understood, will shortly be in full production by the Turner Manufacturing Co. Ltd. Very satisfactory performance has been given by a number of these units undergoing test under service conditions. Several models are designed to operate continuously at speeds up to 3,000 r.p.m. For a given output, these are about one-third smaller and less than half the weight of the conventional types.

The new exhauster is similar to the vacuum pumps supplied in very large numbers, by this manufacturer, for the operation of instruments and de-icing equipment on

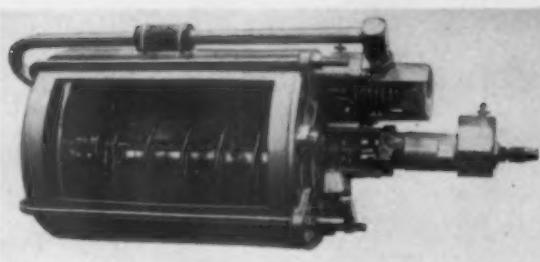


Illustration of the Clayton Dewandre reservoir type Hydrovac vacuum servo, sectioned to show the general arrangement of its components

aircraft. It is of rotary, sliding vane, positive displacement type, and operates in either direction of rotation. The vanes are interlocked within the body of the rotor, which is mounted on roller bearings and is rotated eccentrically in relation to the bore. Semi-circular grooves along the edges of the vanes carry thin metal slips, or shoes, that are in close contact with the bore. The slips are of a special shape that ensures sealing at all positions of rotation without the use of cams or springs. When wear has taken place after prolonged service, oversize slips can be fitted.

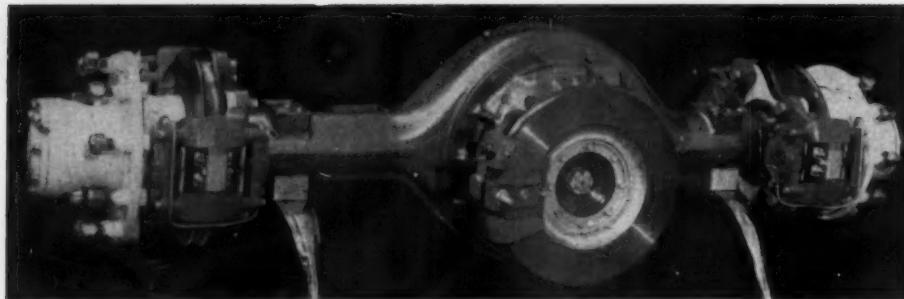
Fodens Ltd. exhibited an example of their new rear wheel brake. This has roller-ended shoes, 7 in wide, expanded by an S-profile cam. Operation is by a Bendix-Westinghouse, diaphragm type air pressure cylinder mounted on the camshaft support bracket, which is secured to the back-plate. As in the case of the Lockheed heavy-duty cam brake, each shoe is retained by a central bolt that passes through a coil spring, which is compressed when the nut is tightened.

The latest commercial vehicle disc brakes do not differ in design and principle from the similar versions seen at last year's private car exhibition. All makes are available with either single- or two-cylinder calipers, having apertures through which the friction pads can be inspected or quickly withdrawn for replacement. Only the Dunlop caliper is a one-piece casting. Although this necessitates the fitting of an exterior pressure-balance tube, it permits the use of one standard size of casting to accommodate cylinders of different sizes. The method of cylinder mounting adopted also ensures more efficient cooling, by air circulation, than is the case with cylinders contained in split caliper castings.

Typical installations of Dunlop hydraulic disc brakes



Lockheed 12 in  $\times$  4 in transmission brake for vehicles of up to 10 ton gross weight



Dunlop rear wheel and transmission disc brakes installed on an Eaton, 8-ton, two-speed rear axle

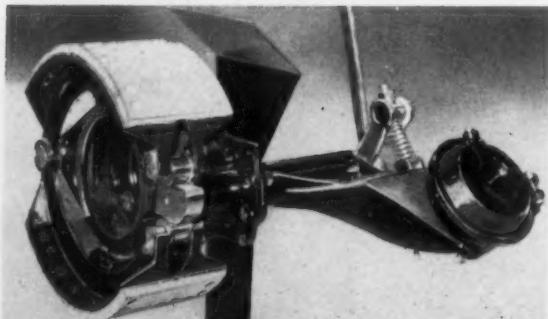
for wheels, and mechanical disc brakes for transmissions were shown on an Eaton two-speed axle. In the demonstration park, similar brakes were also shown on both axles and transmission of a Foden KETU 6/25 tractor. The axle and transmission discs of the latter are  $15\frac{3}{8}$  in diameter and  $1\frac{1}{2}$  in thick. Each rear wheel disc has two calipers, having four  $3\frac{1}{4}$  in diameter cylinders applying four segmental pads, which are  $2\frac{1}{8}$  in  $\times 3\frac{1}{8}$  in and  $1\frac{1}{16}$  in thick. Four segmental pads of the same size are applied to the front discs by single calipers having twin 3 in bore cylinders. The wheel brakes are operated by separate master cylinders, with Clayton Dewandre Type 30 air pressure actuators under control of a treadle-operated DI valve. A variable leverage handbrake lever is connected by a cable to a single, two-cylinder caliper for the transmission brake.

Among the new range of Girling disc brakes, there are six calipers, varying from a single 3 in diameter cylinder type, for axle weights up to 3 tons, to twin-cylinder models of  $2\frac{1}{2}$  in to  $3\frac{1}{2}$  in diameter, for axle weights up to 7 tons. The cylinders and fluid passages are in the caliper casting, which is of the split type with apertures through which the segmental pads can be withdrawn after removal of a single cross bolt.

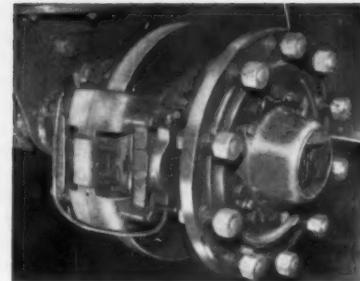
On the new Guy, 18 ft wheelbase, single-deck bus chassis, twin two-cylinder calipers joined by pressure-balance pipes, are fitted to the rear wheel discs, which are  $1\frac{1}{2}$  in wide and integral with the hubs. A wide and deep internal clearance forms an insulating air space that should considerably assist the regulation of heat flow. Larger single calipers are used for the front wheel discs, which are  $1\frac{1}{8}$  in wide. Dual-circuit air-hydraulic application is controlled by a progressive EI type footbrake valve. A  $4\frac{1}{2}$  in wide two-leading-shoe drum brake on the rear end of the back axle worm shaft is applied by a hand lever.

The latest Girling disc type transmission brake, as fitted to the Midland Red buses, has circular pads,  $1\frac{1}{2}$  in thick, applied by a pair of pivoted levers. The outer ends of these levers are forced apart by a wedge type expander actuated by a cable. Their operative ends are fitted with adjusting

Foden S-cam air pressure actuated rear wheel brake on a display stand



The Dyson, 8-ton, four-wheel trailer is equipped with Dunlop disc brakes



screws bearing against the pad back-plate and secured by lock nuts.

Split calipers are also used for the Lockheed commercial vehicle disc brakes, of which there are both the single- and twin-cylinder types. Both have  $15\frac{1}{2}$  in diameter discs,  $\frac{1}{2}$  in thick, and are available with a variety of cylinder bore sizes, enabling the front to rear braking ratio to be regulated to meet requirements. In all cases, the friction material is  $\frac{1}{2}$  in thick, and two segmental pads are applied by each cylinder. The friction pad area applied each side of the disc by the single-cylinder type is  $12\text{ in}^2$ , and by the twin-cylinder type,  $18\frac{1}{2}\text{ in}^2$ . When the retaining plates are removed, after unscrewing two nuts, the pads are easily extracted and replaced. They are not withdrawn directly, but have to be tilted: this arrangement has the advantage of reducing the size of the aperture, with consequently less weakening of the caliper structure.

Drivers of the Guy Mk II Invincible eight-wheeler will appreciate the advantages of its power-assisted multi-pull handbrake, particularly in hilly districts. The hand lever is of L-shape and leans forward in the off position, where it is supported by a rubber buffer stop. It has a pull-up handle at its upper end and its rear end is pivoted and fitted with a pawl engaging with ratchet teeth in a straight horizontal rack connected to the brake pull-rod. When the handle is pulled up by the driver, the pawl draws the rack forwards to apply the brakes. Forward movement of the rack is also assisted by a solenoid-operated air pressure cylinder, the solenoid being energized by closure of a trigger-operated button switch under the pull handle. A pivoted holding-pawl also engages with smaller teeth cut in the rack, and retains the latter in whatever position it is moved to by hand or by the air cylinder. The forward end of the rack is supported by a spring-loaded plunger to maintain it in engagement with the lever pawl, while permitting it limited vertical movement. The holding pawl can be raised out of engagement with the rack by a cable connected to a thumb trigger on the driver's handle.

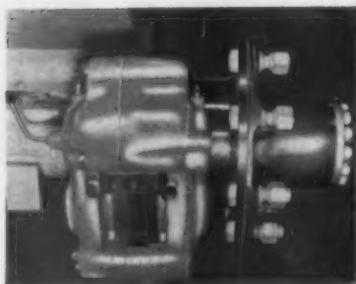
When the driver grips the handle, he closes the electric switch so that the air cylinder operates, immediately taking up any slack and applying the brakes, which are retained in the on position by the holding pawl; the driver can then apply them further by multi-pull operation of the lever.

Up to three pulls are permitted by the ratchet teeth. To release the brakes, the driver pushes the lever down on to the buffer stop and at the same time depresses the thumb trigger to raise the holding pawl out of engagement. The brakes are finally released by pressing down the hand lever further, compressing the buffer stop. A pin on the lever then actuates a pivoted knock-off lever that moves the rack down out of engagement with the pawl. This system of brake control greatly facilitates starting on a steep up-gradient.

The exceptionally powerful handbrake of the Leyland Super Comet will hold the vehicle fully laden on very steep gradients. It is designed with a lever ratio of 300 : 1 and a liner area of 380 in<sup>2</sup>. The hand lever is of the progressive release type, to facilitate starting on steep hills, and is positioned so that the effort required from the driver is as low as possible when a maximum braking is required.

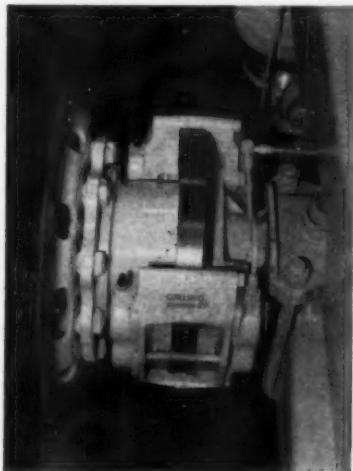
Trailer brake improvement has continued to receive considerable attention by the equipment manufacturers. The new Clayton Dewandre trailer brake incorporates a vacuum reaction valve, with a Bowden cable connection to a hand control lever, and a slave servo, with a C type coupling, for the trailer brake hose. Depression of the tractive vehicle brake pedal brings into operation a master Hydrovac unit so that both tractor and trailer brakes are applied normally as required. By means of the hand control, the reaction valve can be brought into operation to apply the trailer

*A feature of the latest Lockheed, rear wheel, disc brake is the small aperture through which the friction pads can be inspected and removed*



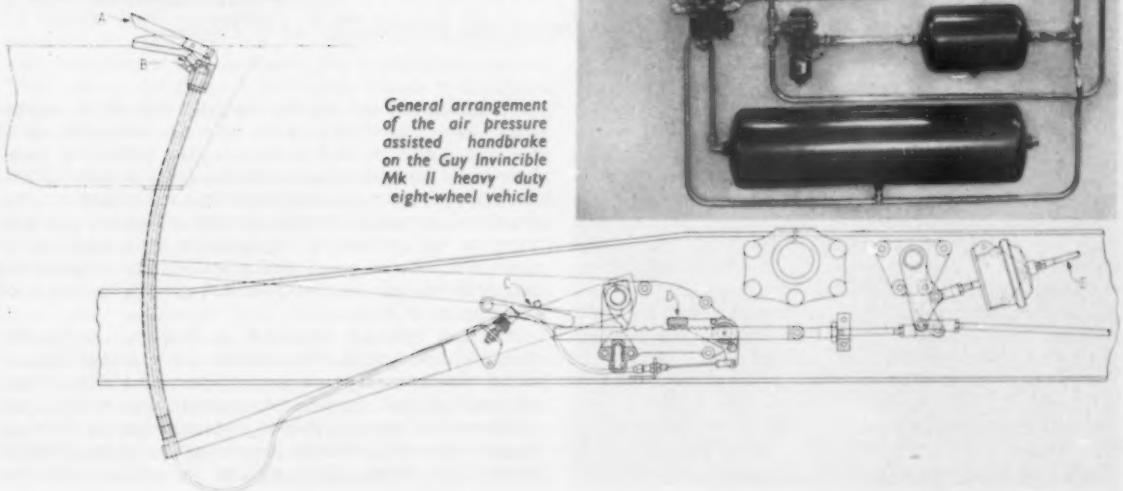
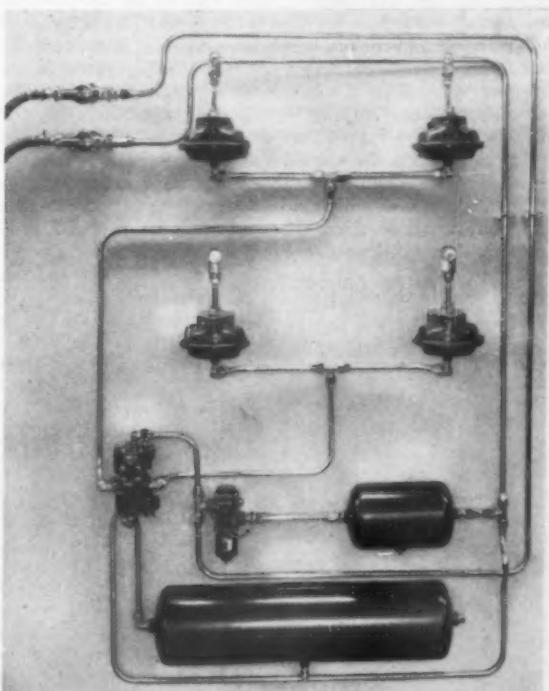
brakes only as may be desirable when descending gradients. The hand lever is fitted with a catch to maintain it in the operative position.

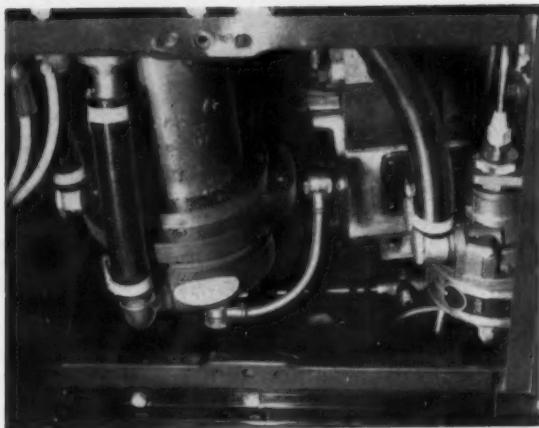
Application of trailer brakes simultaneously with those of the tractive vehicle and in direct proportion to the applied pedal pressure is achieved by the new electro-pneumatic synchronized system introduced by the Westinghouse Brake and Signal Co. Ltd. As applied to a conventional two-line air pressure system of a tractor-trailer combination, with a hand valve for applying the trailer brakes independently of those of the tractor, the electro-pneumatic installation on the tractor includes an electrical supply and a switch mechanism fitted to the foot-control valve. Additions to the trailer system include a magnet valve, introduced between



*Left, Twin calipers are employed on the Girling disc brake equipment used on the Guy chassis*

*Right, Westinghouse electro-pneumatic synchronized brake system for tractor-trailer combinations: this part of the equipment represents the trailer installation*





On the diesel-engine version of the Land-Rover, the Feeny and Johnson vacuum trailer brake control equipment, comprising a motor driven exhauster and dual-control hydraulic reaction valve are under the seat

the emergency and service lines. This is as close as possible to the service line port, in the relay emergency valve, to eliminate delay time due to propagation of air along the service pipe. There is a small reservoir between the emergency line and the magnet valve, and in the service and emergency lines there are also two chokes. The purpose of the reservoir and chokes, which have different characteristics according to requirements, is to ensure that operation of the magnet valve does not result in a pressure drop in the emergency line, causing emergency application of the brakes; they also ensure a maximum degree of inshot to the relay valve when the magnet valve is energized. When the brake pedal is depressed, the magnet valve is actuated, so that a supply of air from the trailer reservoir is added to that normally supplied from the tractor. This provides synchronized and balanced braking of both vehicles. In the event of any electrical failure the normal two-line braking is unaffected.

The latest Feeny and Johnson vacuum trailer brake control equipment is designed particularly for the diesel-engined Land-Rover, drawing a trailer equipped with a

single-line vacuum braking system. It comprises: a 12 volt motorized exhauster and a dual-control hydraulic reaction valve mounted under the driver's seat, a hand control attachment on the steering column and a combined trailer brake hose coupling and isolating switch assembly mounted at the rear of the Land-Rover frame. When the trailer hose is uncoupled, the exhauster motor is electrically isolated, and when it is coupled, it moves a spring-loaded plunger that operates a micro-switch, thereby completing the electrical circuit of the motor. The reaction valve is operated either by normal use of the brake pedal, to apply the tractive vehicle brakes, or by the hand control to apply the trailer brakes additionally or separately. The isolating switch is connected, by a pipe, to a vacuum reservoir; when the degree of vacuum falls below a predetermined minimum the motor is brought into operation and is cut off again when the deficiency is restored.

Of special interest was the first appearance of two Dyson trailers that were equipped with disc brakes. One was an 8 ton four-wheel trailer with air-hydraulic braking and air suspension. Dunlop single-cylinder calipers are mounted at the leading edges of the front wheel discs, and two-cylinder calipers at the trailing edges of the rear discs, with balance pipes to equalize the friction pad pressures. For the handbrake, the single pads each side of the discs at the front are mechanically applied by pivoted levers. Diaphragm type air cylinders, mounted amidships, operate two hydraulic cylinders, from which there are hydraulic connections to a relay valve and to the front and rear brake calipers. The brake system has an air reservoir separate from that of the vehicle's air suspension equipment, so that should the latter fail, it is automatically shut off and therefore the brake system is unaffected.

A Dyson Aeride Haulmaster 15-17 ton tandem axle semi-trailer has Girling disc brakes on the four wheels. Each disc has two calipers with circular pads mechanically applied by pivoted levers and wedge-operated expanders. Power application is by air pressure from a reservoir carried by a cross-member and connected to an operating cylinder mounted at the centre of each axle. The air cylinder piston rods are coupled to pivoted levers, from which there are direct rod connections to compensating levers that equalize the braking pressure applied by each pair of calipers. The pivoted lever on the forward axle is also operated in the conventional manner by a handbrake lever arrangement.

## Frames and Body Structures

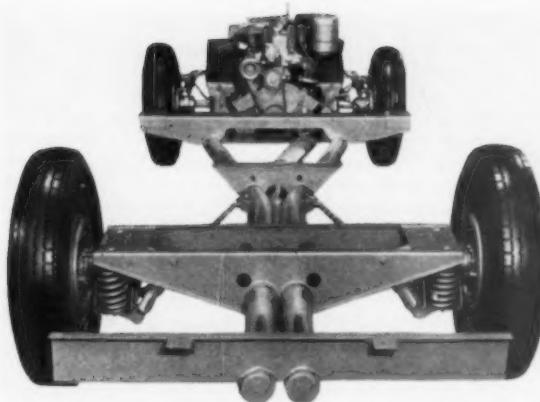
### *Reductions in Weight and Floor Height and Increasing Use of Plastics*

RECENT developments in frame design are aimed mainly at reducing vehicle weights and the floor heights, and at affording greater stiffness. Many well tried designs remain virtually unaltered although there have been minor improvements. However, in some instances, radical changes have been introduced. For example, the Daimler Co. Ltd. now have box section side-members at the front ends of the frames of all their double-deck chassis except those of the underfloor-engine type. This has been done after extensive research and tests, carried out in conjunction with the frame makers. The additional weight of the frame is fully justified, since the extra strength and stiffness thus obtained has enabled the weight of the superstructure to be considerably reduced.

Another interesting feature of construction developed by this company is the employment of glass fibre reinforced plastics for a radiator grille panel, wings, engine cover panel

and lamp housings. In this vehicle, drivers of average height have a good view of the near-side wing, the top of which is at a height of 3 ft above ground level. The entire front panel, incorporating the radiator grille, is easily detachable without the dismantling of wiring and accessories, and when it is removed the engine can be withdrawn in a forward direction for servicing or replacement in a minimum of time. A counterbalanced spring-loaded stay supports the bonnet in the open or closed position and obviates the need for external catches.

Atkinson Vehicles Ltd. can be described as bespoke chassis builders, since their vehicles are in a large measure of special-purpose type, designed to customers' requirements and made in small numbers. It is greatly to the credit of this company that they are able to produce, from the drawing-board, successful vehicles containing so many different features. Inevitably, prices are high for such a service, but



A backbone type frame is employed on the Jensen Tempo 1500 chassis

delivery is good. The makers state that the first special Omega vehicle, as exhibited, was delivered within twelve months of the order being placed. It is designed to operate in ambient temperatures of as much as 135 deg F. With an engine developing 275 b.h.p., and pulling a weight of one hundred tons, it will climb a one-in-four gradient. The combination and range of engines, gearboxes, and axles available enable vehicles to be provided for almost any purpose. Limits of wheelbase, drawbar pull, type of drive and engine capacity desired are specified, and from these data, vehicles are designed to meet special needs. Most of the design is based on empirical data derived from wide experience gathered over the years.

The Austin Omnicar has now been modified in minor details to comply with the Ministry of Transport's requirements for hire as a public service vehicle. These alterations in no way alter the basic structure or limit the use of the chassis for the purpose of carrying omnibus, truck or van bodies. The tendency today of utilizing one basic structure for a varied series of requirements is to be commended, and should facilitate progress in industry. Too often design staffs appear to be bedevilled by demands for something different instead of for something better, and it is encouraging to see that the larger corporations, by rationalization of design, are overcoming this tendency.

Bonallack & Sons Ltd. manufacture a detachable, blown discharge, bulk container. An interesting feature of this vehicle is its dual purpose. Either a bulk tipper or flat platform type body can be installed. A conventional form of tipping gear is employed. When required, the tank, complete with discharge unit, is lowered on to the platform and located and secured by means of four special attachments. These are in the form of rectangular blocks with tapered sides, which slide into sockets provided in the platform; they are secured by quick-release pins. When the truck is used for normal purposes, the sockets are filled by dummy blocks. The change-over can be carried out in thirty minutes. Heat-treated extruded aluminium alloy framing and the Bonallack patent Dekaloy flooring continue to be a feature of this company's products.

Dennis Bros. Ltd., of Guildford, have broken new ground in offering their Loline double-deck chassis. Examples fitted with coachwork were exhibited on the stands of Willowbrook Ltd. and Northern Counties Motor and Engineering Co. Ltd. A special feature is an axle casing, the centre of which is cranked, or dropped, and the ends of which are rigidly attached to the frame. This enables a low central gangway, extending the full length of the vehicle, to be adopted. The frame side-members are dropped mid-way between the wheels and also at the rear, so that

either a central or rear entrance can be provided at the same level as the central gangway. On this chassis it is practicable to build a double-deck vehicle having an overall height of 13 ft 6 in, an interior headroom of 6 ft, and seating seventy passengers. This departure from conventional practice in frame design should be to the advantage of many operators who are at present forced to run either single-deck vehicles, or to reroute their stages to avoid low bridges.

Park Royal Vehicles Ltd. have produced a vehicle offering similar advantages, namely the Bridgemaster. It has an integral structure, and A.E.C. running units are employed. In a bus body exhibited on the A.E.C. stand, seventy-six passengers can be accommodated. This body is based on an aluminium alloy channel section underframe, extending between the front and rear bulkheads, and a sunken gangway extends the full length of the passenger carrying portion. Deep transverse members are employed and the main body pillars are carried up to the roof. These pillars support the upper structure, which forms a unit amply strong to support the weight of passengers and the stresses imposed by torque reaction from the power and transmission units and normal road shocks. It appears that there is a wide range of applications for the Bridgemaster.

In the case of the Bridgemaster, variations in design could not readily be incorporated without considerable rechecking of the main structure, a matter not to be lightly undertaken for only a few bodies. Therefore, smaller operators will probably be attracted by the Dennis Loline because of the relative ease with which special features can be incorporated without in any way interfering with the mechanical structure of the chassis.

These two designs set out to achieve the same object but do so in a completely different way: one by the use of a frame and the other by the employment of unitary construction. The technique of the design of unitary construction is not easily mastered, and it is essential that the principles be

*The Dennis Loline chassis has been designed for a double-deck body. A special feature is the cranked, axle casing to clear the gangway*





A noteworthy feature of the Park Royal Bridgemaster double-deck bus is the low rear entrance step

fully understood if serious failures are to be avoided. This type of construction, as opposed to the conventional frame design, has passed preliminary tests and further developments may be expected.

Fodens Ltd. exhibited a variety of cabs, including a composite wood and steel structure panelled with aluminium, a glass fibre reinforced plastics type and, on the FE 6/30 dumper, a heavy cab fabricated in 14 S.W.G. steel sheet. For this special cab, a rectangular form has been adopted. The need for a separate framing structure is largely obviated by turning the edges of the panels at right-angles. Manganese steel, to specification En 14, is used for all main frame members, the extra cost being well justified by the high strength : weight ratio thus obtained.

The Ford Motor Co. Ltd. have introduced a new Thames range from 30 cwt to 7 ton. Their 12-seater estate car is of special interest, being a useful multi-purpose vehicle for use as an estate car or hotel and station bus. A door at the centre of the near-side gives access to the rear part. An automatically operated side step is fitted; it rises when the door is closed, leaving a clean body side. Double doors, with a fixed step, give access to the rear of the vehicle. A

roof rack of adequate capacity is fitted and the windscreens is of the one-piece curved type, giving ample range of vision.

Jensen Motors Ltd. exhibited, among others, five vehicles, each on a similar type of chassis. The frame design is a development of the tubular backbone arrangement, with box section cross-members, which has been popular for some time on the Continent. Its main components are two steel tubes, which converge behind the engine installation and then extend parallel to the rear. The box section cross-members carry the body. The rear wheels are independently sprung on twin helical springs, and are located by radius rods. This arrangement is used on four of the five vehicles, but the fifth, a truck with an elevator body, is different: the body is carried between the tubular side-members, to which the wheels are attached, and it can be raised or lowered hydraulically, the power being provided by an engine-driven pump. Goods can be loaded with the body at ground level or at any other convenient height.

For maintenance of overhead power lines, or any other work of this nature, a hydraulically operated tower can be mounted on the truck body. In the raised position the maximum working height of the platform is 25 ft. When the tower is lowered and stowed in the truck body, the overall height of the complete vehicle is 10 ft. Among the other vehicles in the range are a 14-seater bus, fitted with a reinforced glass fibre body, and a 25 cwt truck. This truck is a low-loader, with floor height of only 1 ft 10 in.

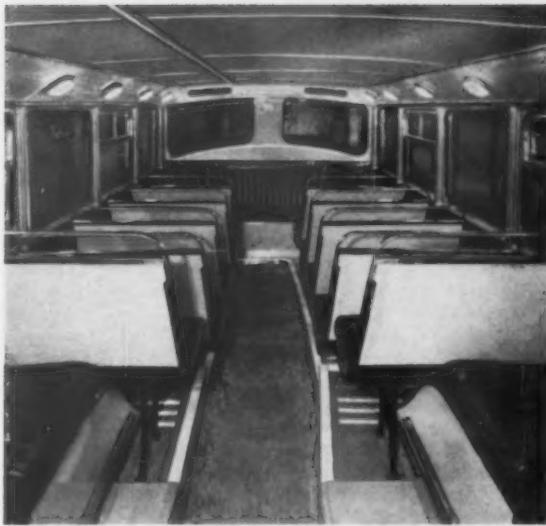
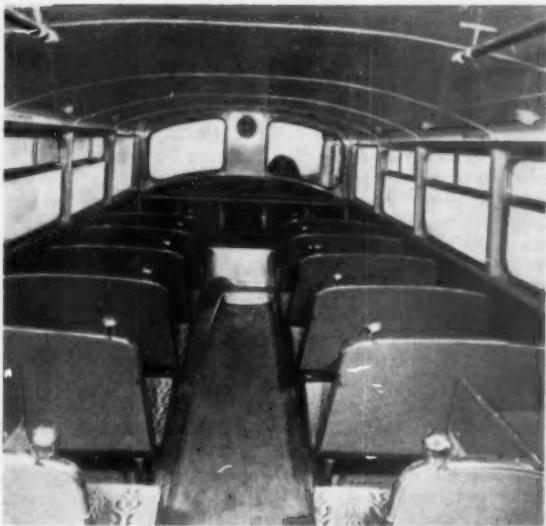
The weight-carrying capacity of the Leyland Super Comet has been increased by 2 ton. This capacity increase has been effected by the addition of a flitch plate, of inverted L-section, on the outer face of the main frame member on each side. The reinforcement extends between the front and rear spring anchorages. Because of this additional frame stiffness, it has been possible to reduce the weight of the body structure.

The Vista Vue cab used on this model is built on a sub-frame on special mounting pads on the main structure. Not only do these pads insulate the cab from the normal

Right: Front entrance of the Willowbrook bus on the Dennis Loline chassis



Left: The Jensen Tempo hydraulically actuated tower wagon, with the tower in the retracted position. In the raised position the maximum height of the work platform is 25 ft



Two views showing central gangway arrangements: left, the Park Royal Bridgemaster on the A.E.C. chassis; right, the Northern Counties Dennis Loline

frame stresses and shocks, but also facilitate removal of the cab. Double-skin, glass fibre reinforced plastics panels reduce drumming to a minimum and, with a modern heating and demisting system, contribute much to the comfort of the driver. In fact, driver comfort is now receiving increasing attention by designers; this progressive outlook is to be commended.

On the frame of the Leyland Atlantean rear-engine chassis, a separate rear extension carries the engine and bumper. The weight on the rear end increases the tractive effort obtainable without slip of the rear wheels. Also, by its cantilever effect, it reduces the bending moment on the main frame section.

Charles H. Roe Ltd. exhibited a body on an A.E.C. Reliance 43-seater coach. It is available with a forward entrance. The door, which swings inwards is controlled by the driver. Two-way hinged lights are provided over the central gangway, and the driver's upward vision is catered for by two domed lights above his head. A very large back light is incorporated, and the only other windows are the side lights. The provision of an excess of top lighting, by means of cant rail and corner lights, has been rather overdone in some vehicles, and some passengers find this uncomfortable on a long journey in very sunny weather. The majority of the finishers, the covers for the ventilator trunking, and also the seat-backs are made of glass fibre reinforced plastics. To provide a finish that will not be defaced by slight scratches, these components are embossed to match the trim. The method used has been to cover the inner moulds with embossed leather cloth, the surface of which is reproduced on the components. Plastics finishers for the interior of coaches have now almost entirely replaced the older style of polished wooden fillet finishers.

Trojan Ltd. are offering a new 25 cwt chassis, which replaces the earlier 20 cwt type. The wider chassis frame now provided carries a body, the capacity of which is 350 ft<sup>2</sup>, and the increase in chassis weight is very little. Independent front suspension with wishbone type horizontal trailing arm control is now fitted to all models.

Transport Equipment (Thornycroft) Ltd. still favour frames made from pressed steel channels of deep section, with bolted-on cross-members; no welding is used in the fabrication. They have recently developed a glass fibre reinforced plastics cab which weighs 40 per cent less than

a normal steel cab. By virtue of the use of plastics, repair and maintenance requirements are reduced to a minimum, the anti-drumming properties are good, and coolness in a tropical climate is claimed. The advantages are said to more than outweigh the additional cost, which is about 20 per cent more than that of a corresponding steel cab. It is of interest to learn that semi-skilled female labour is largely employed for the production of this cab.

A survey of the truck bodies, indicated that the use of timber for the floor, sides, and tailboard, is confined largely to bodies where low prime cost is the main consideration. It is interesting to see that Dodge Bros. (Britain) Ltd. use this material for their platform truck body, which has been well received by their customers. This manufacturer is by no means alone in the use of this form of construction: many of the larger manufacturers still favour the employment of timber for certain applications. In a number of instances, a steel channel underframe, with cross bearers, is used. In some of the exhibits, however, ash is used for the under structure, in conjunction with a timber floor above.

Although, by comparison with light alloy construction, timber structures are inexpensive, their weight is greater. Maintenance costs of aluminium alloy structures are low. In fact, manufacturers of bodies made of this material claim that, provided the design is sound in general and that stress raising features are avoided, the aluminium structure outlasts the rest of the vehicle. This means, of course, that so far as the structure is concerned the more the vehicle is used the greater the economy of operation. There is another factor in favour of the use of aluminium alloys, as opposed to timber, apart from the more apparent saving in weight. It is that so far as open trailers are concerned, water absorption may considerably increase the weight of timber.

The Skoda truck body has a wooden floor. On this truck, the cab is unusual. Accommodation is provided for four, including the driver, all on separate chair type seats. This enables two crews to be carried comfortably for very long journeys. The windscreen, with its curved corner lights, the curved rear corner lights, and the large back light, afford excellent vision all round. Metal panels are employed for the cab, and a cloth head-lining is fitted, doubtless to deaden drumming and other noise.

In general, steel construction is favoured for tipper truck bodies for carrying sand or similar loads. The interior

corners of the steel skin of the container in most instances have large fillet radii, to form a pan without angles from which it is difficult to dislodge the loose load. In most instances, the external framing is of top hat or U-sections welded over their whole length to the inner skin. It is felt that full length welds are better than tack welds, since crevices in which corrosion can start so easily are inevitable in structures welded at intervals along their length.

In the L.T.E. bus design, as carried out on the Park Royal Routemaster, timber is practically eliminated. The floor structure is in aluminium alloy, and consists of a corrugated section, with a flat sheet riveted on top of it. Long strips of a rubber-cork non-slip composition, stuck *in situ*, cover the rivets, while the open underside of the corrugations are filled with a soft, glass fibre anti-drum compound. Pre-stoved parts are now used entirely in the assembly of this vehicle. This obviates the difficulty of stoving the complete structure. A further advantage of the construction is the facility with which damaged panels can be replaced.

Access to the roof panels, from the interior, by removal of the inner skin, facilitates repairs to the cant rail dome. This is an asset, since this panel is particularly liable to damage by overhanging trees. Whether the fixing of external panels

without the use of a heavy interpanel sealing compound is satisfactory, can only be proved in service.

The seat frames are now made in stainless steel tubing instead of aluminium. Although stainless steel is more costly, there is no risk of its staining passengers' gloves. Another interesting feature is the construction of the staircase in two sections, so that either part can be removed in the event of its being damaged—a frequent occurrence with the lower section. Many features of this vehicle design are largely the outcome of the results of extensive tests carried out at the M.I.R.A. proving ground on an earlier prototype. The results indicate just how valuable such investigations can be in the development of new ideas in design.

Whether the public will fully approve of the fixed windows on the front of the upper deck on a hot summer day is open to question. People have a liking for a cool breeze, in preference to piped cold air supplied through the ventilator system. On bodywork in general, many new ideas are being examined and tried. The good ones will persist and the less satisfactory dropped. Designers have always in mind the need to please the user, while making their products attractive, inexpensive and good, and so long as competition exists these will always be the ultimate goals.

## Electrical Equipment and Heaters

### *Increasing Interest in the Four-Headlamp Lighting Arrangement, and in the Employment of A.C. Generators*

PROBABLY the outstanding developments in the electrical sphere are the C.A.V. four-lamp lighting system and the increasing application of the A.C. generator to heavy vehicles, particularly public service vehicles. Any development that reduces the strain of night driving for commercial vehicle drivers, by providing more effective road illumination, is to be welcomed, even though it may entail higher initial cost and heavier lighting load. The C.A.V. four-lamp system is an improvement in this respect, and also minimizes dazzle to oncoming traffic. Other new developments designed to improve vision at night are the Marchal matched fog and driving lamps and new Siemens-Ediswan double-filament headlamp bulb.

The difficulty of maintaining the battery in a good state of charge on public service vehicles, with their heavy lamp load, has intensified interest in the A.C. generator which, by

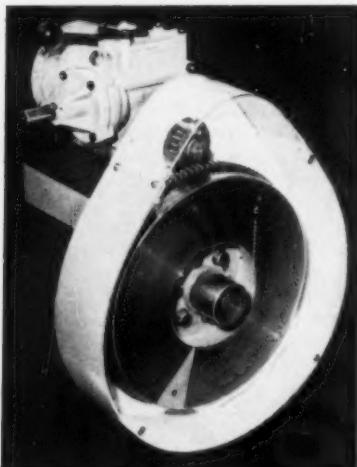
comparison with the D.C. dynamo, has a wide operating speed range and a capacity to give full output at relatively low engine speeds. Once the A.C. generator is well established on the heavy vehicles, its application to lighter vehicles is not likely to be long delayed.

There is a general trend towards reducing size and weight by improved design; examples of this trend are to be found among the latest batteries and the new C.A.V. and Simms starter motors. A notable development in instrumentation is the Smiths Motor Accessories Division all-electric instrument panel, which facilitates dustproofing for certain export markets and obviates the necessity for careful routing of live pipes, thereby reducing assembly time and cost.

Noteworthy among other accessory exhibits were the AC-Delco sealed electric horn and the Vivid Arc speedometer; the C.A.V. type T2 direction indicator with its flexing arm; also the Lucas improved Screenjet and the same firm's overhanging-load rear lamp designed to meet the now applicable legal requirement of a rear lamp on loads that extend more than 3 ft behind the vehicle. Since the comfort of drivers is essential to efficiency and safety, the latest Smiths' heaters are worthwhile developments. In the field of automatic and semi-automatic gear changing, the exhibits on the C.A.V. and Smiths' stands, while not new developments, are still of considerable interest.

#### Generators

An interesting addition to the British and Continental ranges of D.C. generators is the C.A.V. type D13TB, 13 in diameter generator of the overhung pattern, designed for trolleybuses. It is driven by an extension of the traction motor shaft. The C.A.V. and Scintilla units were good examples of the A.C. types; they are of similar general design in that both are three-phase machines with rotors of imbricated-pole construction having the excitation winding wound round the shaft and enveloped by the rotor poles. Current is supplied to the excitation winding through slip



*Simms manually operated inertia starter for application to tractors*

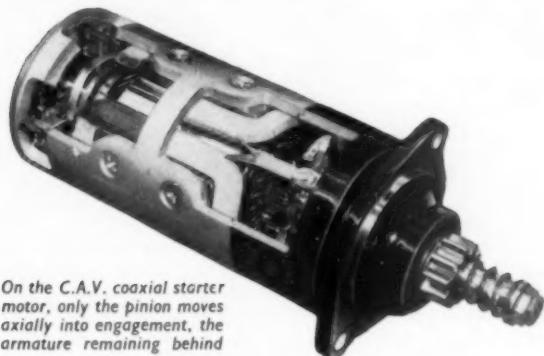
rings and carbon brushes and, since the excitation current is quite small, long and trouble-free service should be obtained. The windings in which the output current is generated are carried in the fixed stator surrounding the rotor poles. The windings, slip rings and brushes are enclosed to exclude dust and dirt and the designs are robust.

Regulation of the generator output is effected by means of a vibratory current-voltage regulator of conventional design. The three-phase A.C. output current is converted to D.C. through the medium of a metal or germanium rectifier, the choice being largely decided by installation conditions. An indication of the output characteristics of such generators can be obtained from the facts that the C.A.V., 8 in diameter, 12 volt unit has a cutting-in speed of 800 r.p.m. and attains its full output of 60 amp at 1,250 r.p.m. Its nominal maximum speed is 6,000 r.p.m. but it could safely be driven at a higher speed if necessary. For comparable output, the A.C. generator is smaller and lighter than the D.C. generator but, when making a comparison, account must also be taken of the rectifier weight in the case of the A.C. type of machine.

#### Starter motors

Appreciable reductions in size and weight have been effected in the new C.A.V. and Simms starter motors for large diesel engines. The C.A.V. type CA45 coaxial starter is a new design in which only the pinion moves axially into engagement, and not the whole armature as in the earlier axial types. This enables the full efficiency of the magnetic field to be utilized. Pinion movement is effected partly by the action of a solenoid and partly by means of the helices on the shaft and pinion.

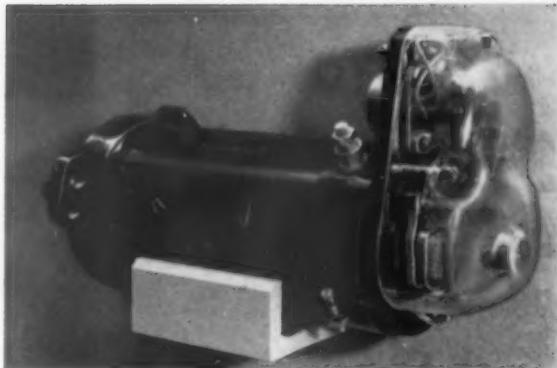
Engagement of the pinion occurs in two separate but continuous stages. When the starter switch is pressed, the solenoid is energized to move the pinion towards engage-



On the C.A.V. coaxial starter motor, only the pinion moves axially into engagement, the armature remaining behind

ment with the flywheel teeth. At the same time a set of moving contacts closes to pass current, limited by a resistance, through the windings; this results in slow rotation of the starter armature. As soon as pinion engagement occurs, the rotating pinion and stationary flywheel react to force the pinion into full engagement, thereby completing the first stage. Just prior to full engagement, a trip switch is actuated to start the second stage: the resistance is short-circuited, full current is supplied to the windings and maximum starting torque is applied. By virtue of a locking device, premature ejection of the pinion is prevented. When the engine starts, the pinion moves out of engagement and current to the windings is interrupted. This new 4½ in diameter starter has a torque capacity in every way comparable with the earlier 5 in design.

A similar improvement in performance has been obtained with the new Simms type 524SGRH201/8 starter motor, which is, in effect, an improved version of the firm's standard 6 in diameter motor. Not only has the diameter been reduced to 5 in but, under comparable conditions, the new



Simms new starter motor is not only 1 in less in diameter than the earlier model, but also gives an appreciably higher engine cranking speed

design gives a higher cranking speed than the earlier model.

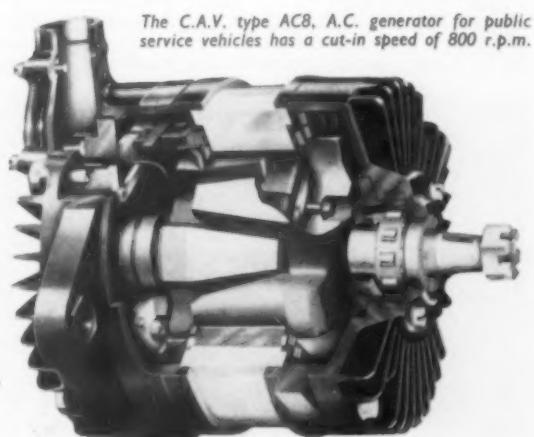
To permit a diesel engine to be started, for emergency or other reasons, without use of the battery, Simms have introduced the Tensec inertia starter, which is interchangeable in mounting with the electric starter motor. The inertia starter, as is well known, was first applied to aircraft engines and the principle of its operation is the storing of energy in a flywheel, by running it up to a high speed, and then applying that energy to crank the engine.

The flywheel is accelerated manually, through high-ratio gearing, by turning a large cranking handle until the flywheel has attained the required speed. A lever is then moved to bring the starter pinion into engagement with the engine flywheel teeth so that the stored energy is utilized in rotating the engine crankshaft. This it will do for two revolutions or more, depending upon the engine and the starting conditions. As the engine fires, the pinion automatically disengages.

Operation of the Simms's inertia starter follows this normal procedure except in that, while the starter flywheel is being manually accelerated, its pinion is moved into engagement with the engine flywheel teeth, so that the crankshaft is slowly rotated through auxiliary gears in the starter. This arrangement helps to free the engine and prime the injection system. The Simms's starter is very robust and of compact design, occupying no more space than the electric starter.

#### Lighting

The four-lamp lighting system displayed on the C.A.V. stand is an alternative to the double-filament block-lens light unit which, with a pre-focus bulb, admittedly provides good light distribution and effective road illumination.



The C.A.V. type AC8, A.C. generator for public service vehicles has a cut-in speed of 800 r.p.m.



*Marchal Uni-Visorim, matched pair of universal-fitting fog and driving lamps, which can also be mounted in place of existing flush-fitting lamps*

Nevertheless, the fact remains that the production, from one lamp unit, of two beams with different functions—that is, long-distance driving and short-throw meeting beams—necessitates some sacrifice of the maximum efficiency of both beams. By providing individual optical systems for the driving and meeting beams, as is the case with the four-lamp lighting system, the highest possible effectiveness in light control and distribution can be obtained with each beam.

Two lamp units are recessed into the wings or bodywork on each side of the vehicle; they can be side by side, one above the other or diagonally arranged, as best suits the vehicle layout. Each pair consists of one lamp unit with a single 50 watt filament, designed exclusively to provide the long-range main driving beam, and a second lamp of the double-filament type. This latter unit has a 50 watt filament at the focal point of the reflector, intended to provide the best practicable meeting beam, and an additional  $37\frac{1}{2}$  watt filament below the 50 watt filament, to produce a wider and deeper beam of shorter range than the main driving light unit. On main beam, all four units are in use, giving a total of 175 watts ( $2 \times 50$  plus  $2 \times 37\frac{1}{2}$ ). For the meeting beam, only the second pair of units is used, with a total of 100 watts ( $2 \times 50$ ).

The lamps are metal-backed  $5\frac{1}{2}$  in diameter units, with individually focussed and soldered-in bulbs. They are carried in seating rims, which are attached by three-point mountings to the lamp body pressing. One of these mountings takes the form of a hard rubber pivot and the other two are adjustable spring-loaded assemblies; it follows that independent adjustment of the lamp unit in the horizontal and vertical planes is afforded by two screws only. Connection to the bulb is effected by means of a three-prong adaptor.

*The Guy Invincible exemplifies the C.A.V. four-lamp installation. By the provision of special optical systems for the driving and meeting beams, highly effective light control and distribution are obtained*



To give freedom of choice in positioning on the vehicle, the lamps are supplied separately with individual rims or with one-piece rims embracing each pair of lamps.

A new matched pair of universal-fitting fog and driving lamps, which can be fitted in place of existing flush-fitting side lamps and/or flashing lights, is the Marchal Uni-Visorim. While primarily intended for fitting in existing flush locations, these Marchal lamps can be mounted as extras on any convenient space on radiator grille or bodywork. When required to replace side and flashing lights, they incorporate a main flasher 45/18 watt bulb and a 6 watt side-lamp bulb.

Other new units in the Marchal lamp range are the Popular fog and long-range lamps, which are lower-priced versions of well-known earlier patterns. The new Siemens-Ediswan double-filament pre-focus bulb has been specially developed to minimize dazzle, for which purpose it is provided with a shield over one filament.

#### **Controls, switches, batteries and battery chargers**

Noteworthy among the control panels exhibited was the Smiths' new all-electric instrument panel. In this, thermal-type indicators incorporating bi-metal resistance elements operating on the make-and-break principle are employed for temperature, vacuum, oil and air pressure and also fuel indications. The advantage of this type of indicator is that a steady reading is obtained and, in the case of the fuel gauge, fluctuations due to vehicle movement, which are generally experienced with the moving-iron type of indicator,



*This rear lamp equipment is designed for attachment to overhanging loads on commercial vehicles. It meets the new legal requirements for rear lamps on loads that extend more than 3 ft behind the vehicle*

are entirely eliminated. Included in the panel is an electromagnetic speedometer, and since all connections to the panel are electrical, dust-proofing is facilitated. Moreover, the panel is readily detachable for servicing. A voltage regulator is incorporated to ensure that the supply to the indicators is maintained at 12.5 volts, thereby eliminating errors caused by the large variations in the battery voltage owing to load conditions.

In general, generator and lighting panels followed conventional lines, though there were some innovations such as the C.A.V. type 210 combined switch, fuse and control unit, which gives ready accessibility of fuses, and also the Simms' matched control panels with interchangeable mountings for chassis and coach body installation. A useful accessory is the Lucas model 56SA, combined switch and warning lamp for use in conjunction with reversing lamps or with fog and long-range driving lamps. When pulled, the actuating knob lights up and so provides the warning required by law when reversing lamps are in use.

While no striking developments in battery construction were apparent, apart from the Oldham Pg design, there was

In the Oldham type Pg battery, perforated PVC tubes are used in conjunction with glass-fibre sleeving, to retain the active material



Above: Lucas model 56SA, combined switch and warning lamp for use in conjunction with reversing, fog, or long-range headlamps

general evidence of improvements in construction and technique, introduced to increase battery life and to reduce weight and size. A new Silver Exide 6 volt battery, type 3XNFB21/19HCL, in a hard-rubber container with integral lifting handles, has been introduced for use on diesel tractors.

Crompton-Parkinson Ltd. have introduced, for the home market, a heavy-duty battery having factory-sealed charge; this enables a battery to be put into service after only a few hours' additional charge, instead of the customary four or five days. New techniques developed by the Lucas organization primarily for passenger service vehicles have now influenced the design of other batteries, including those for goods vehicles and tractors. Included in the range of Siemens-Ediswan batteries are two new FS15 units assembled in hard-rubber monobloc containers; these are designed for use in restricted spaces. Peto and Radford exhibited a wide range of Dagenite batteries with special vent plugs and terminal pillars, which are claimed virtually to eliminate the risk of corrosion.

With the object of providing a battery life comparable with the expected vehicle life, Oldham and Son Ltd. have introduced their Pg pattern, the construction of which is based on the Swedish Tudor battery design. The important feature of the Pg battery is the use of perforated PVC tubes in conjunction with glass-fibre sleeving to retain the active material. The Pg plate consists of a number of thin perforated PVC tubes each of which is lined with a woven glass-fibre sleeve, the assembly being centred on a feathered spine of X-metal, an alloy used for the grids of Oldham batteries for some time. The active material is closely packed into the space between the spine and the glass-fibre sleeve. By reason of the thinness of the PVC and glass-fibre walls, a greater volume of active material can be packed into each tube. Apart from the longer life and consequent saving in battery costs per annum, it is claimed that this design also shows a considerable weight saving by comparison with the conventional battery. Not the least noteworthy feature of this double-sleeve multi-tube construction is its resistance to bursting and vibration.

A wide range of battery chargers, mainly of the metal rectifier pattern, was in evidence on the stands of Siemens-Ediswan and Westinghouse Brake and Signal Co. Ltd. It was interesting to note that the well-known Tungar

battery charger, in which the rectifying properties of the diode valve are used, and which has been marketed by Ediswan for so many years, is still competitive for certain applications with the metal rectifier charger. Such rectifiers are normally of the selenium or copper-oxide types, though where space is at a premium, the germanium rectifier is finding increasing application, especially where heavy outputs of the order of 50 amp or more are required.

Of the new developments in this sphere, the Westalite style A.B.C. automatic charger for radio-equipped vehicles—such as those used for police, fire and civil defence duties—is of interest. This is a new mains-energized selenium rectifier unit, providing a regulated charge and fitted with a D.C.-sensitive relay to cut off the charge when the charging current falls to two-thirds the initial current for a battery in a low state of charge. This arrangement precludes excessive gassing and loss of electrolyte as well as over-charging of a battery. Models are available for 6 and 12 volt batteries and maximum charging currents of from 2 to 6 amp.

#### Accessories

Among the improved and new accessories were the AC-Delco sealed electric horn and the AC Vivid Arc speedometer. The former is a completely sealed unit, even to the exclusion of adjustment of the contacts; for this reason the construction, which includes a striker plate of synthetic bonded material, is designed to compensate for contact wear. In the Vivid Arc speedometer, which operates on the magnetic-drag principle, and is designed for ease of reading, the conventional pointer is replaced by a transparent plastic disc illuminated edgewise and having an orange, arched band marked on the face of the disc, adjacent to the periphery.

The AC-Delco Vivid Arc speedometer is designed for ease of reading, and it operates on the magnetic-drag principle



Westalite style A.B.C. automatic charger for radio-equipped vehicles, such as those used for police, fire and civil defence duties. It is a mains energized, selenium rectifier unit, fitted with a D.C.-sensitive relay to cut off the charge under the appropriate conditions



Since this band, for constructional reasons, can only extend over an arc of 120 deg, the base beneath the disc is similarly marked with an orange band. This second band is so located that when the disc is angularly displaced more than 120 deg, the band on the base is visible through the clear portion of the disc. In this way, the two bands are used in conjunction to give a continuous orange band for 240 deg, which is the maximum angular displacement of the disc. The speed indication is given by the leading edge of the disc lining up with the markings on the surrounding scale.

Joseph Lucas Ltd. exhibited an improved version of their Screenjet all-electric windscreen washer, suitable for all classes of vehicle, and a more powerful screen wiper, the model FW2, intended for screen-mounting on light vans, trucks and also sports cars with folding windscreens. The C.A.V. type T2 semaphore direction indicator, with its flexing arm, was also of interest as exemplifying robust construction combined with immunity from the damage such as could result from inadvertently striking an obstacle, for example, a garage door. Specializing in heavy-duty equipment Trico-Folberth Ltd. displayed a comprehensive range of electric screen wipers and semaphore and flashing-light direction indicators.

#### Electrical control in transmission systems

In recent years a great deal of research and development effort has been applied to the problems of automatic gear-change control, mainly because automatic transmission greatly reduces the physical and mental strain of driving. Such a reduction is becoming increasingly necessary in the case of public service vehicle drivers, especially those operating on busy city routes. The electrical gear-change control systems exhibited by C.A.V. and Smiths are, therefore, of interest as indicating the current development stage of British manufacturers.

The C.A.V. fully automatic electrical gear-change control system is applicable to direct-acting epicyclic gearboxes with either electro-pneumatic or electro-hydraulic operation. The equipment comprises:

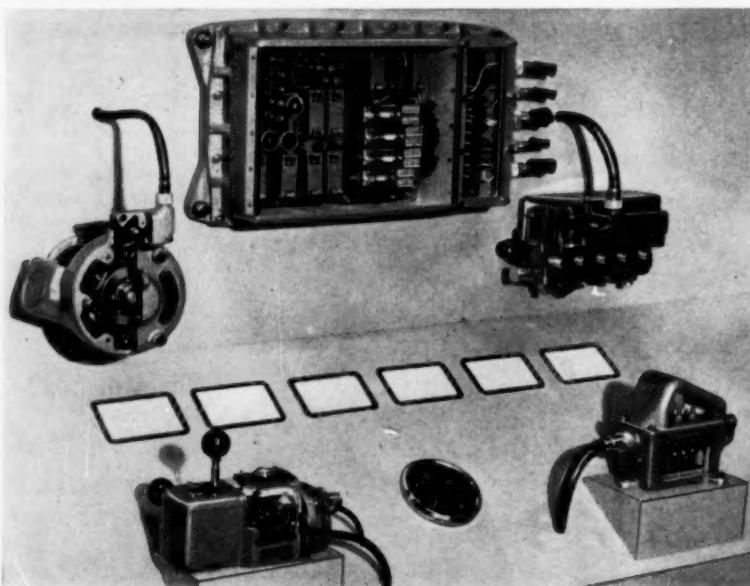
1. A gear-selector unit, normally mounted on the steering column and connected by a cable to the control unit.
2. An electro-pneumatic or electro-hydraulic valve, depending upon the method of gear selection; this valve is mounted on the gearbox casing of the vehicle chassis.

3. A speed-sensitive alternator driven from the transmission shaft.
4. A torque-sensitive switch actuated by the accelerator pedal and taking current from the battery through the control unit.
5. The control unit, which translates electrical signals from units 3 and 4 into the required gear-changing actions.

Briefly, the gear-selector unit can be set for manual or automatic control. In the former case, the required gear change is effected through the medium of the selector switch and valve circuit, as in a normal gear-change operation. When the gear-selector unit is set for automatic operation, and a start is made from rest with the engine running, depression of the accelerator pedal brings into operation the torque-sensitive switch to engage the starting gear, which can be either the first or second ratio in the gearbox. All gear changes are then completely automatic, the ratio in use being chosen by the control unit to suit the road speed and engine torque, as indicated by the electrical signals transmitted to the unit from the speed-sensitive and torque-sensitive devices. The control unit integrates these signals on relays, which actuate the gear change. A number of features is incorporated to cater for varied driving conditions and to ensure maximum safety, efficiency and reliability.

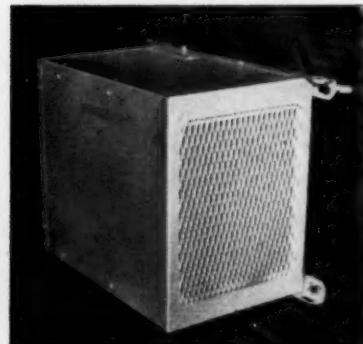
The Smiths' Autoselectric system for commercial vehicles depends for its operation on a magnetic-powder coupling, which in a smaller and modified form is also used in a fan drive for commercial vehicles. In this coupling, the drive is transmitted from one rotary member to another through the medium of iron particles, of about 325 mesh, in an annular space between two members that constitute a substantially closed electro-magnetic circuit. When current is passed through the energizing coil, the resultant magnetic flux attracts the particles and packs them tightly in the annular space; in consequence, a torque is transmitted from the driving to the driven member.

The amount of torque the coupling will transmit is almost proportional to the energizing current. When the coupling is de-energized, the iron particles fall loosely apart, thereby breaking the virtually solid drive between the two members. A feature of the Smiths' coupling is the absence of judder as the drive is taken up. This smooth take-up is obtained because the energizing current is substantially proportional to engine speed. Rapid freeing of the coupling for changing



Left: Components of the C.A.V. automatic gear change system laid out on a display stand

Below: Smiths type R550 coach heater designed for mounting underneath the seats; it is said to give a heat output of approximately  $5\frac{1}{2}$  kW



gear is effected simply by interrupting the energizing current.

The Autoselectric fully automatic transmission essentially consists of:

1. Two powder magnetic couplings used in conjunction with a conventional layshaft type gearbox, which they drive through coaxial input shafts.
2. A governor, which is an electrical switch device sensitive to road speed and accelerator depression, and which is driven by a flexible cable from the rear end of the gearbox.
3. A control unit which serves to relay the governor signals to the automatic transmission in order to effect the appropriate gear changes.

The magnetic coupling that is nearest to the engine drives direct to the gearbox output through a solid mainshaft, whereas the output member of the second or indirect-drive coupling, which is nearest to the gearbox, is a splined tubular sleeve around the mainshaft; this drives the gearbox layshaft through constant-mesh pinions. Integral with the layshaft are the first and second gears, in constant mesh with corresponding gears that are free to rotate on the mainshaft. The mainshaft first gear is coupled through a free-wheel to a ring, which can be locked by a manually controlled dog-coupling to the mainshaft, for first-gear operation. The same control gives reverse by engaging a gear keyed to the mainshaft with an idler gear driven by the layshaft.

When the vehicle is started from rest, the indirect-drive coupling is energized and drives the layshaft through the constant-mesh first-gear pinions and the free-wheel unit to the rear axle. When speed and torque conditions, as sensed and integrated by the governor-control unit system, demand a change to second gear, the indirect coupling is de-energized and, at the same time, the direct-drive coupling and also the second-gear actuating solenoid are energized. Pending synchronization, the direct-drive coupling transmits torque under slipping conditions but, simultaneously with gear engagement, the electrical control system transfers current back from the direct to the indirect coupling.

For the change from second to top gear, the energizing current reverts from the indirect to the direct coupling and, at the same time, the second-gear actuating solenoid is de-energized. For downward changes, the sequence of events is reversed. Provision is made in the governor to safeguard against hunting between two ratios, which is likely to occur under certain operating conditions, and also



The Smiths rotary hit-and-miss vent for use with the fresh air heater

to delay downward changes as necessary and to prevent engagement of second gear at any time above a certain road speed.

#### Cab and coach heaters

Noteworthy, as new air-conditioning units, were the Smiths' vehicle cab and coach heaters. The model F376 fresh-air cab heater, which can also be used for ventilating, has a heat output exceeding  $3\frac{1}{2}$  kW. Its denser heater matrix gives greater efficiency in a smaller space than the F375 model, which it supersedes. For use in conjunction with the model F376 heater, there is a new hit-and-miss rotary vent affording easier arrangement of the fresh-air intake and greater control of the heater. The model R301 is a recirculation heater designed for the driver's cab of vehicles already in service; it has a two-speed control unit, and is supplied complete with air hose and an adjustable diameter nozzle.

For coach heating, the new R550 heater, designed for mounting underneath the seats, has a heat output of the order of  $5\frac{1}{2}$  kW. The outstanding features of this design are its high heat output and small overall dimensions, which make for ease of accommodation. It can be used with fresh or recirculated air systems, according to the installation.

## Bodywork

### *Great Improvements in Cabs, and Some Well Designed Special Purpose Vehicles*

**T**HIS year to a greater extent than in any previous post-war Commercial Vehicle Show the display of bodywork indicated that there was a feeling of confidence throughout the industry. Examination of the vehicle exhibits demonstrated that the time has passed when models groped their way on to the market. Now they go straight ahead, confident in the knowledge that the bodywork is right for the job anywhere in the world. Among the bodies designed for special applications, models were seen that had been developed under service conditions. Their features are of interest to engineers and operators alike.

One outstanding feature of the Show was the styling of forward control cabs. Broadly, this can be described as a protruding lower area, topped by a set back windscreens. Roof lines, styled to conform to the particular type of windscreens used, were generally lower in the front, taking a gentle sweep upwards to the rear. This styling provides the driver with the maximum headroom required for comfort, and

avoids flat roofs and square corners. Engineers, examining many of the drivers' cabs, could be forgiven for thinking that perhaps they would have been better placed in the Motor Show.

Guy Motors Ltd. have given thought to the comfort and convenience of the man at the wheel, by providing the luxuries of a cigarette lighter and a plug for use with an electric razor. Examination of the design and construction of the huge cabs fitted to the Invincible range of chassis, showed that the panoramic windscreens has eliminated the need for front quarter lights and means that vision is improved, since the blind spot normally associated with screen-pillars is eliminated. This cab is, in fact, assembled in two separate sections. The upper portion, made in glass fibre reinforced plastics material, is easily removable from the lower metal section, the break being along the top of the wing line; the windscreens is incorporated in the upper section.

Throughout the exhibits, the feature of wrap-round



Above: This Seddon cab is typical of the general trend of styling of forward-control layouts. It is of plastics construction and can also be used on a chassis on which the front wheels are further back

Right: The front of the cab of this 520 ft<sup>3</sup> capacity pantechnicon body, by B. Walker and Son Ltd., is of glass-fibre reinforced plastics

front windscreens predominated. The use of reinforced plastics moulding has gained in popularity for a number of practical reasons. Because of the ease of forming this material to desired shapes, it is natural that increasing use of wrap-round windscreens should coincide with the increased use of mouldings. This popularity of mouldings has also led to a considerable amount of work on the methods of designing and producing parts for use on a range of models. For example, on the Seddon DD8, eight-wheel forward-control chassis is a cab on which are roof and rear panels applied also to other models using this size of cab.

Another practical application of cab mouldings was seen on the stand of Walker & Son Ltd. The pantechnicon body, mounted on an Austin L.D. chassis, has a capacity of 520 ft<sup>3</sup>, as compared with 502 ft<sup>3</sup> when the body is mounted in conjunction with the normal metal cab.

On the stand of Scammell Lorries Ltd. a Highwayman, 10 ft wheelbase motive unit was fitted with a unit construction reinforced plastics cab. This cab consists of a series of mouldings built on to a metal floor. Extra transverse rigidity is furnished by a sturdy reinforced plastics instrument panel extending the full width of the cab. The doors comprise inner and outer moulded panels with timber inserts, where necessary, to provide a base for the fixing of the locks and hinges.

Commer Cars Ltd. have retained the same basic styling for their 8 ton model for several years. Evidence of the success of this design is the introduction of forward-control models having the same basic style. The larger cab has a modification to lift the front of the roof by three inches. This has been effected by introducing a flat area immediately above the windscreen.

The Leyland all-metal Vista-Vue cab, fitted to their Super Comet, is styled in the very latest fashion, and the construction is a fine example of the engineering of metal cabs. The basic sub-frame of the cab is a deep, welded box

section rising at the rear end to clear the propeller shaft, and having a clear opening in front of the power unit. Over this opening is a rigid arch section. Two longitudinal steel pressings alongside the engine connect the front to the rear of the frame, to locate the sub-frame accurately on the chassis members. The door frames are pressed from a single sheet of metal, to provide a consistently accurate opening into which the jig assembled door will fit with regular clearance. These frames are welded in position on the outside of the sub-frame. To this heavy framing is fitted a double-skin paneling, in the form of a series of pressings, the space between the inner and outer panels being filled with glass fibre insulation to absorb resonance in the metal sheets. The cab sub-frame is secured to the chassis by means of rubber mountings, the fixing bolts being spring-loaded.

Inside the cab, panels of large area cover the power unit; these are removed when normal routine servicing is required. Engine removal is effected through the front of the cab, this requiring the taking away of the front bumper bar and the large radiator grille. The wrap-round windscreens is large and deep, having a total glass area of 3,000 in<sup>2</sup>. For comfort inside the cab, foam rubber seating with Vynide covering, is employed, and it goes well with the modern full-fronted exterior.

Introduced just prior to the Show, the new Bedford



normal-control driver's cab has a full three-seater capacity. The bonnet-line, falling steeply away to the front, provides good forward visibility, and the windscreens, which is 6 in deeper than on the previous models, is a factor in the increase of 63 per cent more glass area. The cabs on the whole of the range of trucks have been lowered, and this, coupled with the unusually wide, cab entry-step, makes entry and exit an easy matter. One of the service troubles with all metal cabs in the past has been that the under surfaces collect mud and water and ultimately rust away, this process starting where it is impossible to take preventive measures. These Bedford cabs are subjected to Bonderizing of the metal and then receive an underbody dip in a large-capacity tank. This dip deposits a coating of protective paint all over the metal including inside the sections, which cannot be normally reached either with brush or spray.

Styling of the 1959 commercial vehicles is not confined to the cabs. Large and small vehicles show vast improvements in appearance, but remain essentially practical. This combination of practicability and looks is outstanding on those



The Wadham ambulance seat can be reversed, as shown in the centre, to make room for a second stretcher or lifted, right, to disclose the locker

bodies that have been designed for a specific purpose.

On the stand of Wadham Bros. (Coachbuilders) Ltd., there was an ambulance body mounted on a Morris L.D.O.1 chassis. This body, completely built of reinforced plastics material, using a double-skin technique, made the whole vehicle lighter in weight than a similar size of ambulance constructed in more traditional materials. In this construction a series of metal inserts are moulded into the structure for location, as also are plates for anchoring the hinges and locks. The body framing is a series of reinforced plastics angle and top hat sections laid up on the outer panels during fabrication, the interior panels being secured later.

The interior is equipped with stretcher equipment. By means of a series of linkages, the stretcher can be rapidly locked securely on to the carrier, without the need for screwing up with a handwheel. In effect, this means that a patient on a stretcher can be loaded and locked in a matter of a few seconds. The roof, back and front corners and rear doors are all well rounded to provide a pleasing overall appearance and to eliminate dangerous corners.

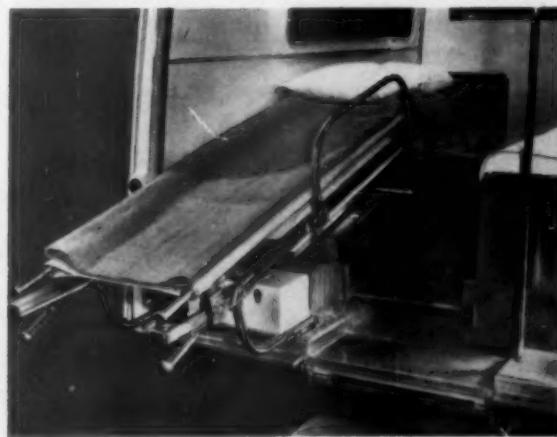
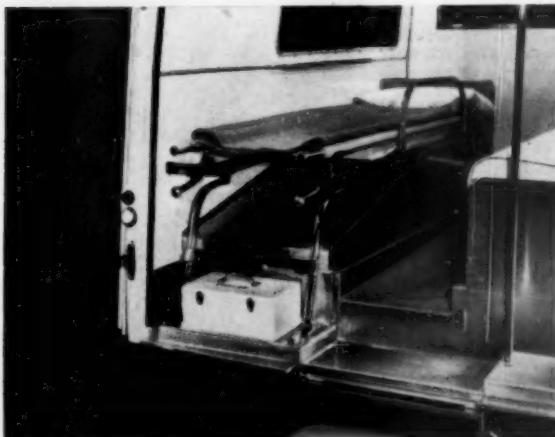
Locomotors Ltd. exhibited a new pantechnicon body mounted on a Morris 3 ton, long wheelbase, forward-control chassis. The framing of this body is of fully heat-treated extruded alloy sections, with hardwood inserts in the pillars to take interior moulding fixings. Five main metal roof-sticks provide rigid anchorage for four hanger rails formed by alloy sections. These rails can carry a collective weight of  $2\frac{1}{2}$  tons of clean clothing. Because of the nature of the loads to be carried, all the doors are fitted with rubber gaskets, so that when they are closed there is little chance of dust entering the van during its journey, even in the worst conditions abroad.

All the outer panels are moulded, colour impregnated, reinforced plastics sheets bonded to the metal framing by wrapping with glass cloth and resin. The roof is a one piece translucent moulding. For the finishing of the whole of the interior, a series of panels of plastics-covered hardboard are employed, and the floor is made of Parana pine surfaced with heavy-duty linoleum to ensure easy cleaning.

In recent years, the transfer and movement of freight and goods by palleting them has grown to a major factor in handling, and this year vehicle body designs produced for just this purpose were shown. Jensen Motors Ltd., in their series of front-wheel-drive vehicles, displayed a 25 cwt elevator truck. The body of this vehicle can be raised from ground level to a height of 4 ft 6 in by means of a hydraulic system, operated by a handle outside of, and just behind, the driver's cab. When rising from ground level, the floor can be stopped at any point, thus allowing goods to be loaded on small hand trucks from loading bays of widely varying heights. The load-carrying part of the body is slung in a sturdy tubular frame extending along each side; this framing forms the chassis and carries the rear wheels.

Another freight transporter mounted on a Karrier Gamecock chassis, was shown on the stand of Edwards Bros. (Tipplers) Ltd. This comprises a van type body mounted on a hydraulically actuated scissors-action mechanism, which lifts the whole body high up above the cab to enable freight to be loaded directly into an aircraft. On the front end of the van body, above the cab, is a large floor extension which forms a large open platform in front of the body when in the fully-raised position, high above the driver's cab. This vehicle can be used for servicing aircraft, all the equipment and tools being in the van portion, while the extension

Interior of the Wadham, plastics ambulance body showing the two positions of the stretcher, and the central floor well giving adequate head room





Dennis Paravan, showing the cab door in the raised position. The lift-up handle can be seen just below the top of the door opening

serves as a working platform, carrying personnel and tools.

James Cocker and Sons (Southport) Ltd. showed an ingenious roller floor in a fully palleted van body mounted on a Dyson 12 ton semi-trailer. Each roller is interspersed with a timber strip, these strips forming the floor. At the end, a set of rollers is capable of being raised and lowered manually above the level of the timber. When raised, palleted goods can be rolled down the full length of the body, and the operation of a handle on the outside and underneath the floor allows the load to be set down squarely and firmly on the timber floor. This innovation enables this 25 ft long body to be fully loaded in fifteen minutes.

A further example of a body structure to suit a particular load was shown on the stand of Karrrier Motors Ltd. It was in the form of a special mineral-water carrying truck with open sides. Welsh top hat sections across the metal floor, together with the same sections in two tiers above the floor, provide a light but very rigid structure for the carriage of crates. The tiers are supported by a series of vertical rods, and all the metal joints are welded.

On the same stand, a 3-4 ton mobile workshop exemplified one method of catering for special work, as distinct from a special load. The body, built by Thomas Harrington Ltd., is in two separate sections. A large cab, for a driver and crew of six, is built ahead of a van type body carrying the maintenance equipment required by the Brighton Waterworks

Department, to whom this vehicle has now been supplied.

Traditional material, that is, timber, is used by J. H. Jennings and Sons Ltd. for rigid horsebox built on a 7 ton Thames Trader chassis, the only one of this class of body in the Show. This is a horsebox with a difference. It is so designed that with all the interior stripped down it can be used for the transport of cattle, pigs or sheep. By hanging in the paddings and matting, and placing the padded cross-bars in position, the interior can be turned into a box to take four horses, all facing forward. Two horses can be loaded in from the wide entrance on the near-side and two from the rear, each opening being equipped with a long sloping ramp. The bodywork is constructed of oak pillars which support mahogany panels, and the heavy ramps are fitted with the Jennings patent ramp springs, used on all horseboxes built by this firm. These springs assist the lifting of the heavy ramps.

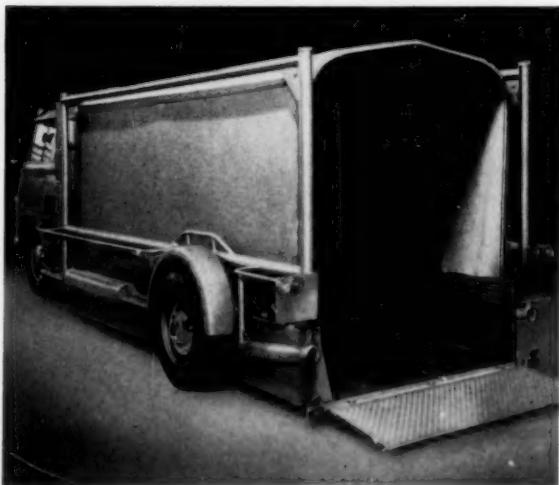
Even though horseboxes and cattle truck exhibits may have been fewer than in previous years, mobile shops showed a decided increase. Three such bodies were exhibited by J. H. Jennings. One is for ice cream vending, one for a butchers and another for a general provision shop.

The butchers shop body is a good example of the incorporation of all the facilities required. In addition to the more usual interior fittings venetian blinds are fitted to the side windows to prevent the sun's rays from striking directly on to meat on the counter. The interior is panelled in a plastics faced hardboard, and the floor is covered with lino. All the features are designed to ensure that the interior of the shop can be easily and regularly cleaned down, so that the meat can be served in a clean, healthy atmosphere.

Martin Walter Ltd., showed a mobile shop as a conversion of the normal Thames 15 cwt van. This design embodies a raised roof, which takes the form of a large reinforced plastics moulding, with its joints along the cant rails.

Customer space is provided at the rear end of the shop, and a large lift-up flap is incorporated above the rear door, to provide headroom. The interior height is 6 ft 1 in. Different arrangements of the interior shelves and counters can be provided, according to the customer's requirements. By virtue of the increased height of the roof, a very large locker can be installed above the driver's head. Access to this locker can be gained through a large flap type door, just inside the body, above the central opening between the cab and body.

In most of the mobile shops on display, consideration has been given to accommodation for waiting customers, the aim being at enabling as many as possible to get inside



Left: Jensen hydraulic elevator truck with the body in its lowest position and the tail-board down, ready for loading

Right: Interior of the body built by Locomotors Ltd. for carrying clothes. The hanger rails are designed to take a total load of 3 ton



during bad weather conditions. Use of valuable interior space for this purpose must, of course, be a compromise between customers' goodwill and the loss of display and storage space.

Parcels delivery vans have received special attention from body designers for a number of years, the main problem being to obtain easy access into the cab, and at the same time providing adequate facilities for loading and unloading on to the pavement. One vehicle designed to overcome this major problem, the Paravan, was seen on the stand of Dennis Bros. Ltd. The chassis has a frame that is cranked down ahead of the front wheels: this has enabled the body designer to provide a low entrance step to the driver's cab. A good feature of this vehicle is that the floor of the cab is on the same level as that of the van. The placing of the entrance door on the front near-side corner of the body and the provision of an upward-sliding door unit have enabled the driver, as he enters, to move past the near-side of the engine and straight into the van. The entrance door of the cab comprises four panels, which slide upwards in an arc, into the roof. Two of these panels have window lights.

The driver can leave his seat and move through a sliding door in the bulkhead into the van. Having collected the goods from inside the body, he returns through the bulkhead door, goes down to the low-level step and out of the van without meeting any obstructions. The whole movement, from leaving the driver's seat to stepping out of the vehicle,



Palletized body by Cockers of Southport; sets of rollers are interposed between the timber slats of the floor. In this illustration, the left-hand set of rollers is retracted, while the right-hand set is raised

takes about 30 seconds plus the time needed to locate the goods required. In the model on display, the framing was of seasoned timber with orange colour impregnated, reinforced plastics panels for the sides and a translucent, reinforced plastics moulded roof and front dome.

Marshall's Motor Bodies Ltd. showed a sales promotion van mounted on a Bedford, 2 ton, long wheelbase chassis. The interior is fitted with a series of perforated panels on the sides, front and on the single rear door. Display samples can be pegged or hung on these perforated panels. The use of the perforations permits a wide variety of shapes and sizes of wares to be displayed.

#### Construction

Among the brilliant and colourful display of finished vehicles, there were a number of exhibits showing how various types of bodies are constructed. On the stand of the Austin Motor Co. Ltd., the constructional features of the Austin Gipsy personnel carrier could be examined in a sectional model, the bodywork being cut lengthwise through the centre.

Spurling Motor Bodies Ltd. exhibited a sectioned model of their well-proved all-steel body construction on which it

A scissors action, hydraulic lifting mechanism is used to elevate the body of this vehicle designed, by Edwards Bros. (Tipplers) Ltd., for loading aircraft

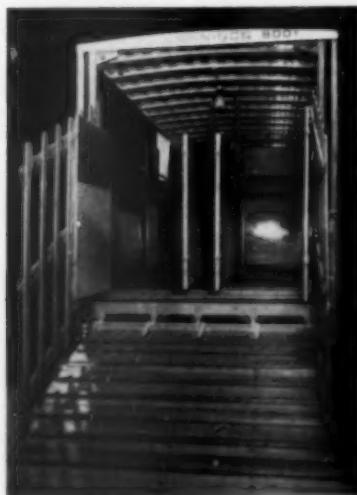


was possible to examine in detail the sections used, the methods employed in joining these sections, how the panels were assembled, the shaping of the wheel arches and the construction of the doors. Such a model provides valuable information to those who are called on to repair damaged bodies of the particular type being shown.

Atkinson Vehicles Ltd. featured a sectioned cab on their 24 ton gross 8-wheel chassis. The off-side of the cab showed the whole of the timber framing employed, together with the method of mounting it to the chassis, while the near-side showed the reinforced plastics mouldings used to panel the exterior. These included a name box incorporated in the front of the roof moulding and showed clearly the smooth lines that can be obtained by including this item as an integral part of the moulding.

Exhibited on the stand of Seddon Diesel Vehicles Ltd. was a sectioned cab and part-body fitted to the front end of the newly-introduced Pennine single-deck bus chassis. On the off-side, the framing was fitted with a series of moulded reinforced plastics panels while the near-side showed the alternative light alloy panels. The roof of this sectioned model is of particular interest because it is of plastics sandwich

In this body built by J. H. Jennings & Son Ltd., four horses can be carried, and all can face forwards





Atkinson Vehicles Ltd. cab, sectioned to show the traditional method of framing. A modern method of approach is indicated by the position of the forward pillar of the door to suit a wrap-round windscreen

construction. The exhibit showed the honeycomb used between the inner and outer panels, as well as the method employed in joining each section, on assembly, by a tongue and groove joint covered with a strip. Since the roof is moulded in sections about 4 ft long, it can be easily crated when these bodies are being supplied for export in a C.K.D. condition.

This model also showed the mechanics of the operation of the entrance doors. A G. D. Peters and Co. Ltd., hydraulic system, actuated by a lever just ahead of the driver's left hand, is used. The doors are opened and closed by cylinders, mounted on the framing above them, used in conjunction with a series of links. Operation of the doors of the model showed that, as well as being opened and closed by the driver, they can be opened manually by a passenger inside the coach. However, once they have been folded back to the fully-open position, they have to be closed by hydraulic action by means of the driver's operating lever. Examples of coach seats that can be supplied with the body were bolted to a short section of flooring. Two of these seats were covered with Fothergill and Harvey Tygan material of unusual and very pleasing weave.

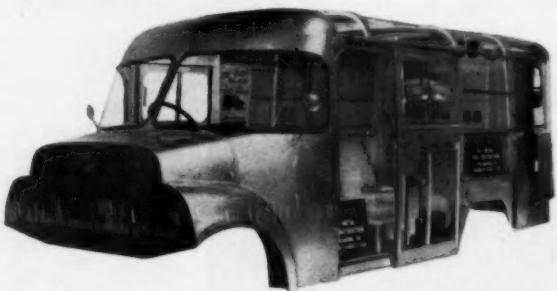
Another sectioned model of bodywork was on the stand of W. P. Butterfield Ltd. It was an insulated tank section mounted on Dyson, air suspension, single-axle running gear. The tank section had a stainless steel end, which was highly polished internally. A portion was cut away to show the reinforced plastics lagging, together with the glass fibre insulation. The lagging cover sheets were part aluminium and part reinforced plastics, once again indicating alternative materials.

One exhibit having an outstanding feature was on the stand of Scammell Lorries Ltd. It was a liquid oxygen tanker, in the form of a semi-trailer having a capacity of 342,000 ft<sup>3</sup>. One of the well known troubles associated with the carrying of liquid oxygen is that it is at a lower temperature than the surrounding air, and this has the effect of distorting the inner tank by as much as two inches. This distortion sets up stresses in solid forms of insulation, so that they crack and come away from their anchorages around the tank. The insulation in this tanker is a development by the British Oxygen Co. Ltd., to whom the tanker was supplied and is an expanded perlite powder known as Brelite. During the building of the vehicle, this powder is poured into the cavity between the tank and the outer panels. The initial filling is well shaken down by running the vehicle on the road

and then more powder is poured in, until the cavity is completely filled. In service, the powder insulation should adjust itself to any change in length of the inner tank without being damaged, thus ensuring complete efficiency of the insulation throughout each journey of the vehicle.

At each Commercial Vehicle Show for some years, there has been at least one unusual tanker exhibit: this year it was a bulk tanker having a capacity of 2,700 gallons of beer. Since the trade name of the beer is "Main Line", and therefore suggests railways, the tanker has been designed in the form of a locomotive. The driver's cab, of course, is at the rear, and a cat-walk is provided along the top of the tank to permit access to the tank opening which is in the form of the steam valve cover. This tanker, built by Darham Industries (London) Ltd., is mounted on a Carrimore trailer chassis.

In the heavy transport field, tipper vehicles showed a wide variety of body design, and a large number of maximum capacity tippers was shown. A new development, and one which will be watched with close interest, is an all-reinforced plastics U-shape tipper body, exhibited by Holmes (Preston) Ltd., and mounted on a Foden chassis. The body is constructed of woven glass fibre reinforced plastics, well radiused at the front and along the sides. This body is supported in an underframing of light alloy extruded



This sectioned all-metal van body, by Spurling Motor Bodies Ltd., demonstrates a method of employing metal sections in construction. Top-hat section pillars are connected to the waist rail, cant rail and metal roof-sticks, and the rear door is double-skinned

sections, with pillars extending up the sides of the body. The outside of the framing is clad with flat sheets of reinforced plastics material. All round the top edges is a capping of light alloy section. This body, as exhibited, has a capacity of 12½ yd<sup>3</sup> and is stated to weigh 9 cwt, which is rather more than half the weight of a normal tipper body of the same capacity.

Heavy metal sections are used by a number of manufacturers, to give adequate rigidity to floor and sides of rock dumper bodywork. Vehicles of this type are of particular interest now that major excavation and road-building schemes are swinging into operation.

On the stand of York Trailer Co. Ltd., a newcomer to this Show, was a 17 ton stake-and-rack semi-trailer, which can be used for bulk and palletized loads. This form of bodywork, which is not often seen in Britain, combines the advantages of an enclosed body with those of the flat platform type. The racks on the sides and ends can be lifted away to convert the unit to a platform body. When the racks are in position, sections at the sides and rear can be swung, to form loading doors. A sheet, laid over a ridge type framing above the racks, forms the cover over the freight being carried.

Displayed by Reall (Coachbuilders) Ltd., was a box van on a Dyson articulated, low-loader, semi-trailer chassis. This body is mounted on the chassis outriggers and the framing is of ash and steel sections. There are floors at three levels,

the distance between these floors being suitable for the carriage of washing machines, the load for which the body has been built. At the rear, a mechanically operated tail lift has been supplied to raise the products up to the floor to which they are being loaded. The ram that actuates this lift is fitted high up, on reinforced roof trusses. It has a cross-head at the rear, from which the operating chains extend down to the tailboard. These chains are carried in channels on each side of the rear opening, which is thus unobstructed. When not required as a lift, the tailboard can be hinged up, and the top half fitted with two doors secured by a locking bar.

#### Passenger Vehicles

Passenger-carrying vehicles, the lightest of which were taxicabs, comprised an important section of the exhibits at the Show. For many years only two firms have exhibited taxis built specifically to the requirements of the Metropolitan Police hiring requirements, and the styling has not greatly changed until this year when, on the stand of Car-bodies Ltd. the new FX4 Austin taxicab made its public appearance.

Styled in contemporary car fashion, with all that this implies, the body is of all-steel construction and is fabricated from a series of pressings spot welded together to form a separate body unit for mounting on a taxicab chassis. Looking closely at the streamlined bodywork, with its high wing and waist lines ending in a swept back quarter, just above the high rear wing, the engineer may wonder just how costly will be the repairs. However, so far as interior space and comfort are concerned, the new design is a great improvement on the earlier ones.

Beardmore Motors Ltd. exhibited the well-established Mark 7 taxicab fitted with traditional composite bodywork. This has been slightly restyled. The rear end is swept out from the waist line downwards, to give an appearance of additional length. The introduction of the Perkins Four 99 diesel engine, as an alternative power unit, has necessitated the lengthening of the bonnet by setting the grille well forward. This extended front end, together with the rear modification, has produced a body having a longer and lower appearance. The roof dome on each of the two models exhibited is a one-piece moulded reinforced plastics unit. All the wings are removable and are also of plastics. The front wings are in two parts, to reduce the cost of replacement in the event of damage to the outer portion.

For rough usage under hard working conditions on contractors sites, a number of bodybuilders have turned, for personnel carriers, to conversions of existing van bodies. One of these, based on a Ford Thames 15 cwt van, was shown on the stand of Martin Walter Ltd. This conversion consists of the incorporation of a side door and slatted seats for twelve persons. The interior was rugged and devoid of anything of a luxurious nature, and therefore is well suited to rough use expected in such work.

Similar conversions, built to comply with the Conditions of Fitness regulations, were also to be seen. These are used as single-deck, one-man-operated, public service vehicles for eleven passengers. For these, the roof of the standard van is raised by substituting for it, a translucent, one-piece reinforced plastics moulding. Longitudinal bench seats, fully upholstered, provide seating accommodation for five passengers on each side of the body. The other passenger can be seated alongside the driver. Above the interior waistline, the body sides are trimmed with a washable PVC covering, and the floor is covered with lino.

A new conception in the design of a 30 ft coach in the luxury class could be seen on the stand of Mulliners Ltd. The full beauty of line could not be really appreciated because of the proximity of surrounding exhibits. This body is constructed of light alloy, both in extruded section and cast forms. Its smooth outside appearance, devoid of

lines of rivets, is made possible by the use of reinforced plastics material and a bonded method of skin application.

All the panels above the floor level are insulated with glass wool. Inside, the panels are of heavily embossed aluminium sheet, with decorative PVC padded panels superimposed between the seats, these panels being removable. A sponge-filled plastics waist rail is fitted along each side of the coach. Above the seats is a set of polished tubular roof-racks, fitted with nylon mesh. These racks can be folded up into the roof when not in use. The well designed seats have individual back and head rests, and are arranged so that the passengers have a wide range of vision. Removable cushions facilitate cleaning.

A transparent plastics dome is incorporated at each end of the roof. The exceptionally deep windscreen units are split vertically at the centre and wrapped well round each front corner. Immediately behind the door glasses, the upper and lower edges of which are in line with those of the windscreen, are two additional large areas of glass. Thus, the driver has a good range of vision all round. The tops of the side windows are at the same level, but their lower edges are higher. At the back, the glass is continued round the rear quarters and across the whole rear end of the body.

The decorative flash, along the sides of the body, tapers away to a sharp point, after traversing about three-quarters of the overall length. It breaks up the side panels, and accentuates the length of the vehicle. A set of huge rear lamps, set in the end of each rear wing, gives a fin effect, while, at the front end, the main moulding tends to fall away in order to provide a balanced effect between the front and rear.

For the ventilation system, fresh air is taken in through a front grille and also through the upper portion of the side windows. Stale air is extracted through a central ducting and also through the side windows. Priced at £3,830 at the time of the Show, this is one of the most expensive coach bodies made in Britain, but it is considerably cheaper than its Continental counterparts.

A double-deck bus for export could be seen on the A.E.C. stand. It has been designed for the Teheran Omnibus Board, from whom an order for 250 has been received. The bodywork is constructed by Park Royal Vehicles Ltd. It has a framing of light alloy and steel sections, with stressed panels. All the main windows in both saloons are of full depth and are provided with sliding panels for ventilation; these are augmented by hinged ventilators at the front windows on each side, two being provided in the upper deck.

Section of the Seddon coach body. The panels on the left are of glass-fibre reinforced plastics, while those on the right are of light alloy material



and one in the lower deck. In addition, sets of louvres are incorporated in the lower deck vent panels. Glass fibre insulation is used in the double skin roof to mitigate the effect of direct rays from the sun.

Park Royal Vehicles Ltd. exhibited the latest example of the L.T.E. vehicle, the Routemaster. To the body engineer, one of the most interesting features about this design is the facility with which components can be replaced in the event of the vehicle's being involved in an accident. Such parts as the driver's cab, the rear platform and staircase, are carried on the main framing in such a manner that they are easily replaced. Aluminium alloys feature largely in the framing construction, the deck floors for example being of corrugated alloy faced with alloy sheet.

The seats, which are covered in moquette and leather, have tubular frames. Polyurethane foam cushions and squabs are employed, because this material is much lighter than foam rubber of equal dimensions. The squab boards are moulded in glass reinforced plastics and are detachable from the tubular framing. Reinforced plastics mouldings are also used for the bonnet top, the rear and emergency window frame and the used-ticket box.

#### Exterior finish

Gone are the days when commercial vehicles were by nature dull and uninteresting to look at. Colourful body-work, especially on the lighter transport, is considered as a travelling advertisement, and many of the exhibits showed up well the masterpieces of the signwriter's art as well as the clever use of transfers. Two-tone schemes, largely made possible by the changed styling, which provides natural break lines without the need to introduce moulding strips, could be seen on many stands.

Among the mass produced vehicles, the Standard Motor Co. Ltd. Atlas van provides a good medium for two-tone finishes. One colour can be applied on the large rubbing area that extends along the full length of the body side and thence forward and upward over the radiator grille, while another colour can be applied to the main body area.

Almost all forward-control cabs provide a natural break-line, while by contrast, many of the large-capacity van bodies, with built-in cabs, are painted in pale colours to prevent the large side areas from becoming too prominent. The trend on these vans seems to be to rely on well balanced signs, to offset the tendency to slab appearance, rather than to introduce a chromium plated moulding along the waist-line.

#### Summary and trends

While the number of public service vehicle exhibits appears to be less than in previous years, the number of commercial vehicles has increased, and design ingenuity surpasses anything seen at previous Shows. Manufacturers of cabs, in adopting panoramic or wrap-round screens, have been quick to take advantage of the change in vehicle construction regulations, which no longer demand that a front windscreen, or part of it, shall be capable of being opened. The use of glass fibre reinforced plastics mouldings for parts of the cab with involved contours is clearly on the increase. In fact, these mouldings can be used to advantage in conjunction with curved screens, especially for products made in relatively small quantities. This material, in translucent form, is now well established for the complete, or central portions of van roof construction.

Demands for light weight and silence for enclosed body-work has been met in several ways. One is the use of moulded reinforced plastics panels, this material being particularly dead. Another method is the use of double-skin metal construction, the space between the two panels being filled with a suitable noise insulating material. The third is the elimination of roller shutters which, despite their utility have always been noisy.

Styling has almost fallen into line with contemporary car trends, while the convenience and comfort of drivers in their daily work, either of long hauls or short door-to-door delivery, have been seriously considered by the vehicle and body manufacturers. There is a noticeable increase in the number of vehicles fitted with external sun visors over the windscreens.

Increasing consideration is evident in the design and construction of bodywork for specialist freight, and it is evident that design work will go ahead in this field, in order to step up the efficiency of transporting and handling specialist loads. Gone are the days when a truck or van body was good enough for almost any class of load. Exhibits of bodywork at the Show gave forceful evidence to operators everywhere that if there is not the exact body to meet his needs and precise specification, it can and will soon be designed and built. Confectionery sales promotion or contractors equipment, heavy haulage or high lifting, lightweight or luxury bodywork, palletization or parcels delivery, workshops or washing machine transportation, all had their place in the bodywork display at the Commercial Vehicle Show of 1958, and more may be seen at the next Show.



The latest trends in coach styling are exemplified by this body shown on the stand of Mulliners Ltd. Much of the paneling is of reinforced plastics

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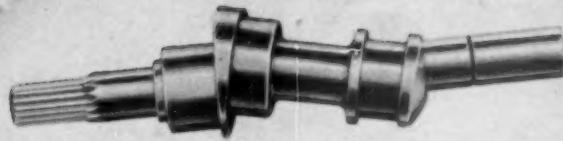
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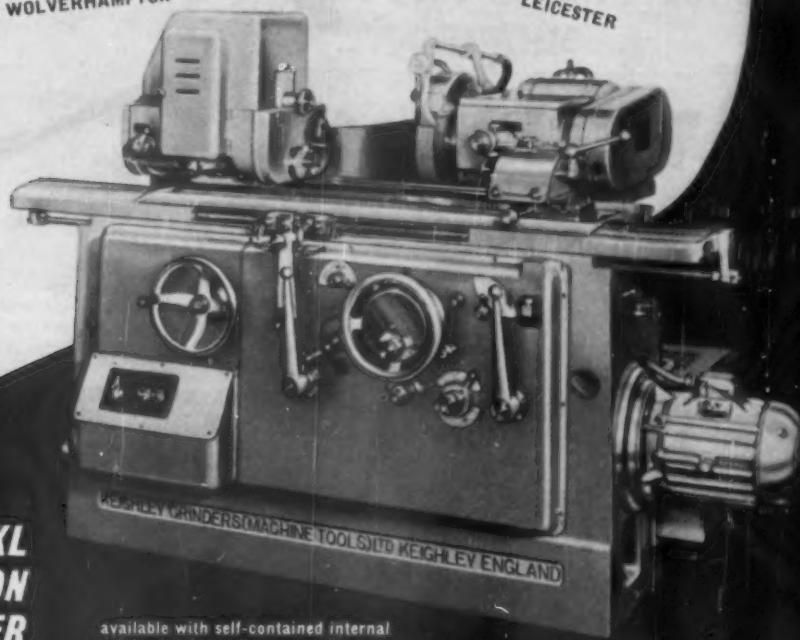
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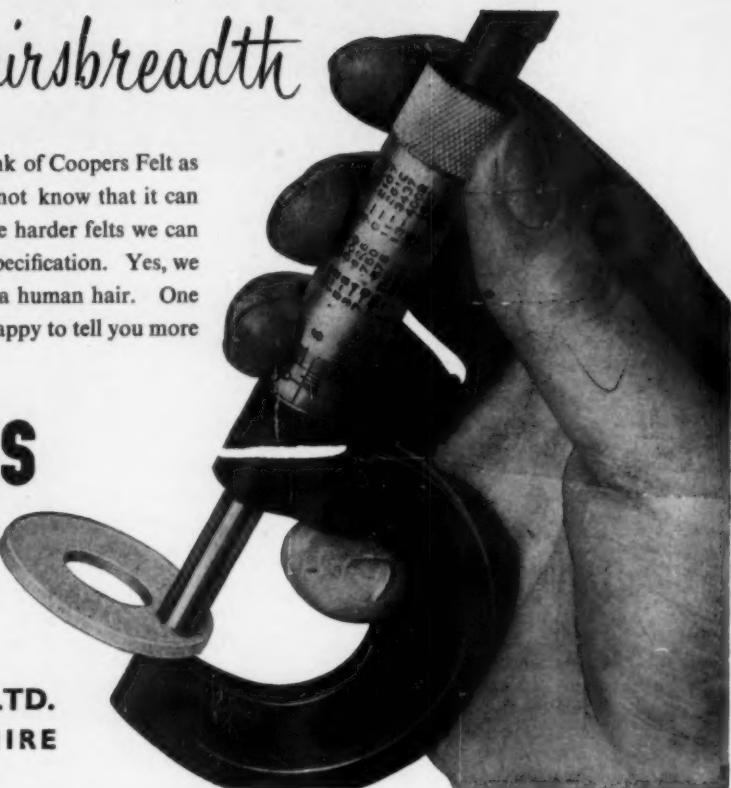
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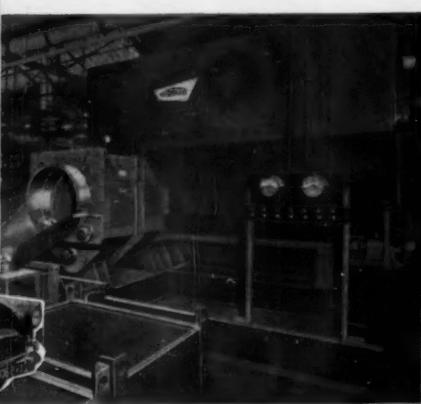
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## Electro-Heat

The ways in which electricity can be used to advantage in industry are many and varied. Some are well known but others are not known well enough. For this reason the Electrical Development Association has prepared a series of detailed data sheets on various applications which will be printed in this journal from time to time.

This Data Sheet is the first of a number devoted to electro-heat—that is, heat produced by electricity for the processing and treatment of materials. Other uses will be dealt with later on in the series.

There is an unalterable physical law that the efficiency of conversion of *electrical* energy to *heat* energy is 100 per cent. The same cannot be said of the efficiency of combustion of any solid or liquid fuel.

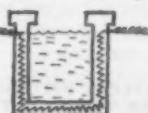
All the applications of electro-heat have these advantages in common:—

- 1 Electro-heat is clean both in regard to its application and the method of generation.
- 2 It can easily be controlled more precisely than any other form of heat, manually or automatically.
- 3 It can be brought to the job instead of having the job brought to it.
- 4 It permits better use of floor space and the elimination of unnecessary handling.
- 5 In many of the newer processes it is the only possible form of heat which can be used.
- 6 It often ensures a higher quality of products with fewer rejects.
- 7 It gives the best working conditions.
- 8 It reduces or eliminates fire and explosion hazards.

Below will be found brief notes on some of the various methods of generating heat by electricity.

### Resistance Heating

This is the best known form of electric heating. The elements provide a high resistance to the passage of electricity and thus heat is generated. It can be used in furnaces for melting or heat treatment of any material whether metal or not, or the resistance of the workpiece itself can cause the generation of heat.



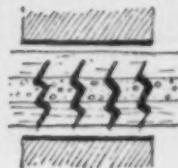
### Induction Heating

Eddy currents are induced in the surface of a conducting workpiece, heating it up. The depth to which this heating will penetrate is determined by the time it is given.



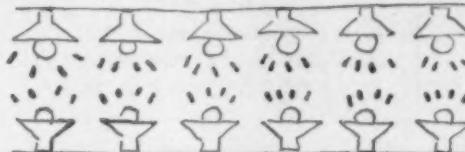
### High-frequency Dielectric Heating

This form of electro-heat can be used only on non-conducting materials such as wood, plastic and rubber. The material is placed between two electrodes to which a high voltage is applied at a high frequency. This has the effect of generating heat inside the material rapidly and uniformly throughout its entire thickness.



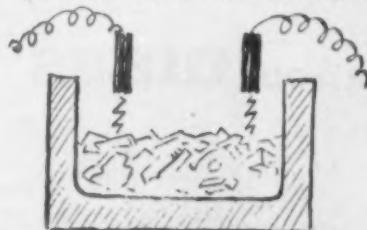
### Infra-red Heating

This method employs pure radiant heat. The bulk of the radiation takes place in the infra-red portion of the radiation frequency spectrum. The heaters may take the form of reflector lamps or sheathed wire elements. The method is extremely flexible and has many uses, including paint drying and pre-heating plastics.



### Arc Melting

This form of heating is chiefly used for melting steel. The diagram illustrates one method of operation.



Very large charges can be melted; melting units of 200 tons capacity are now in operation.

### The Application of Electro-Heat

All these methods of electric heating can be applied in almost an infinite variety of ways. Some of these ways will be dealt with in subsequent sheets.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2.

Excellent reference books on electricity and productivity (8/6 each or 9/- post free) are available—"Induction and Dielectric Heating" is an example; "Resistance Heating" is another.

E.D.A. also have available on free loan a series of films on the industrial use of electricity. Ask for a catalogue.

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*to British Motor Vehicles*

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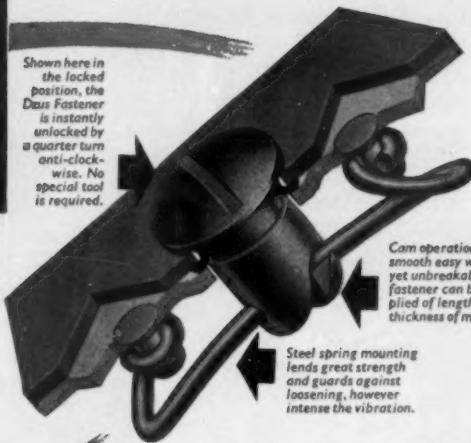
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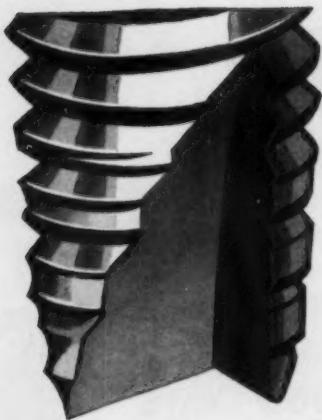
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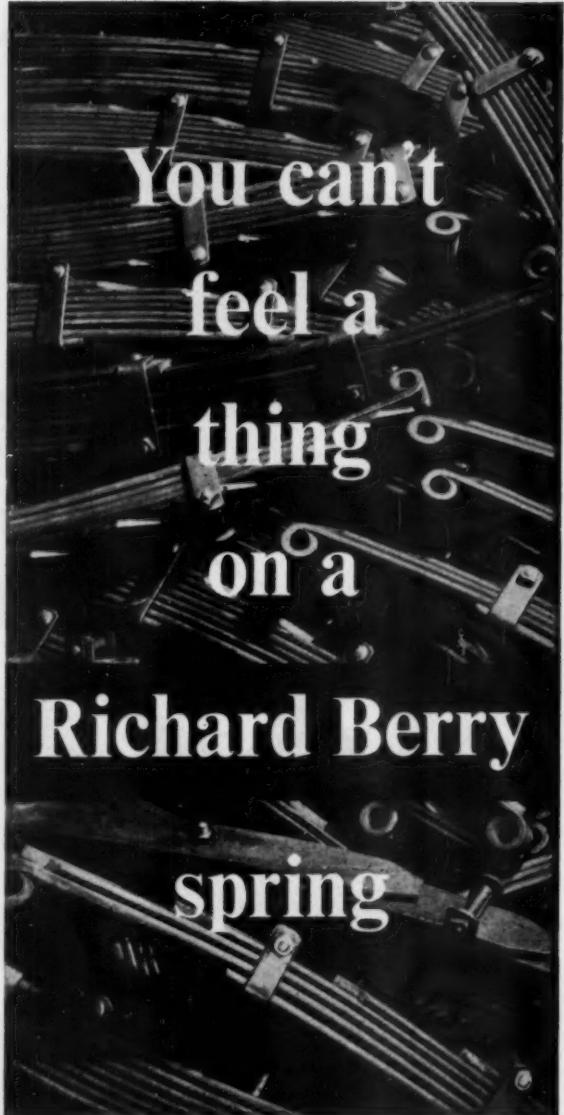


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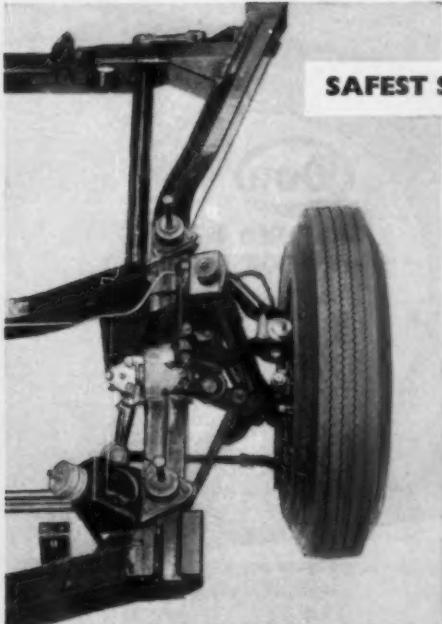
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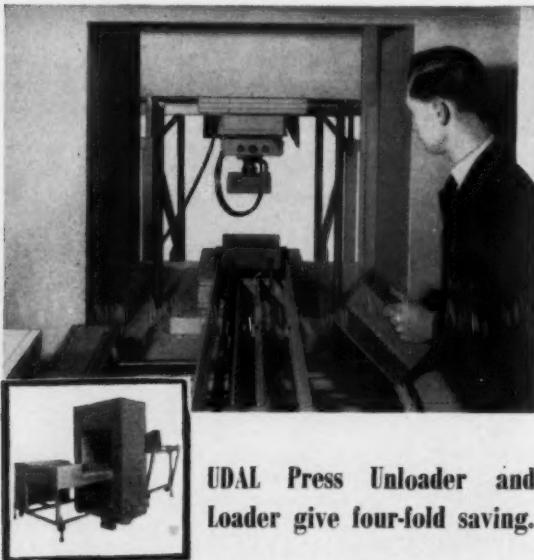
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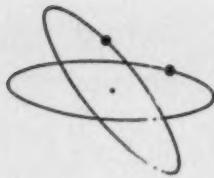
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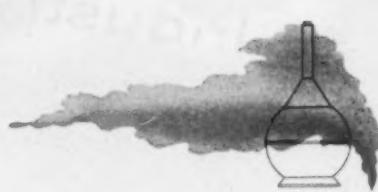
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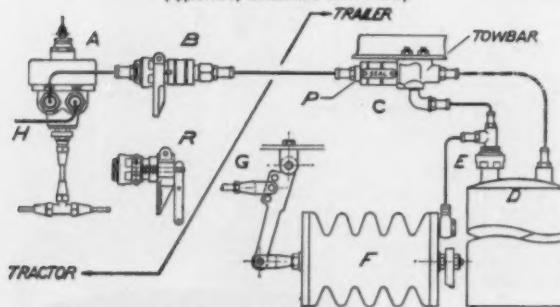
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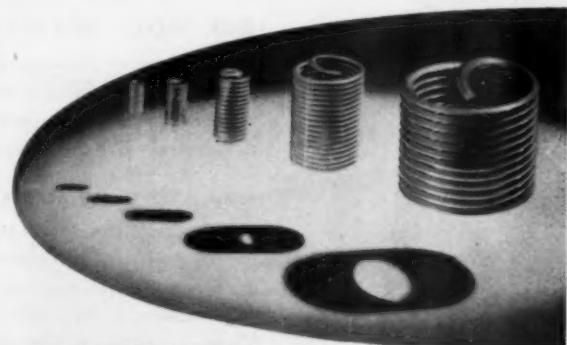
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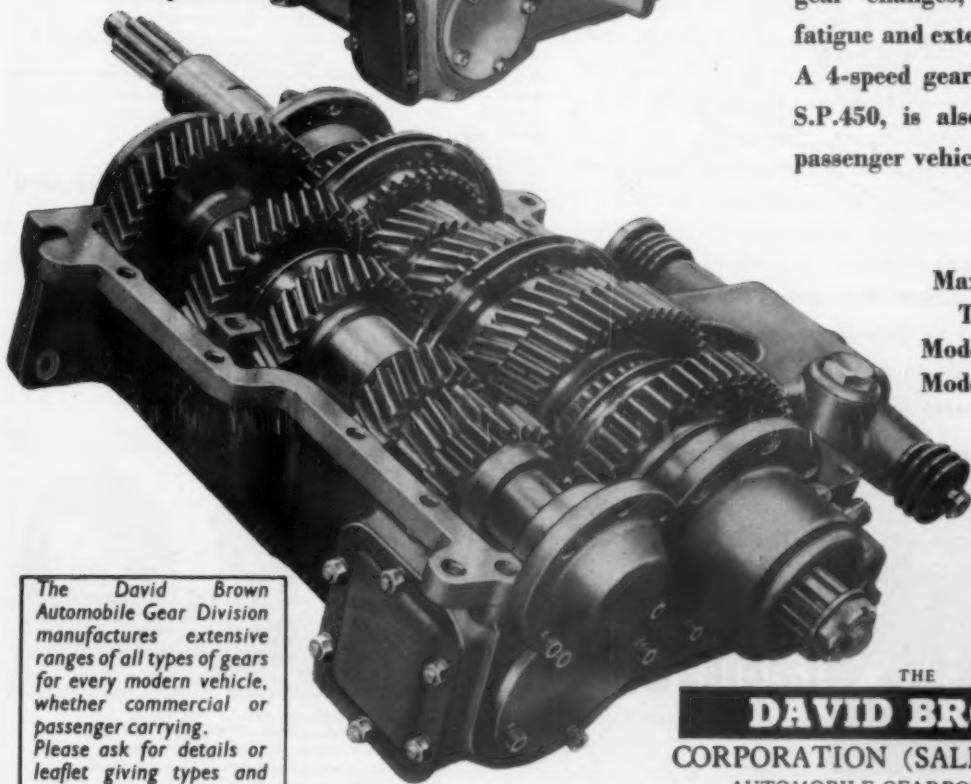
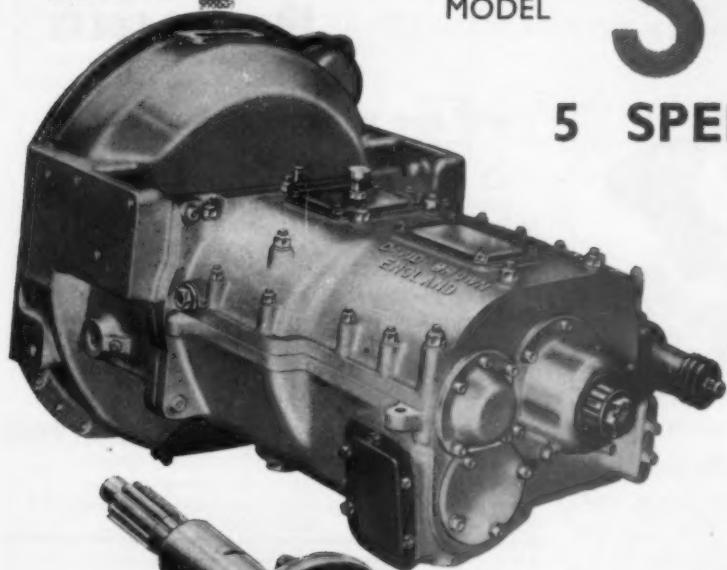
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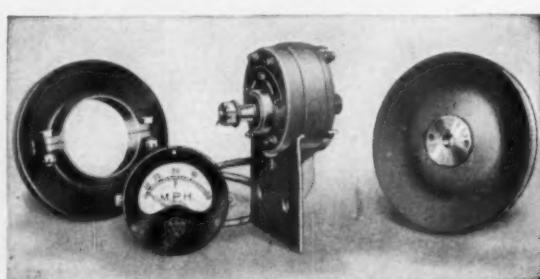
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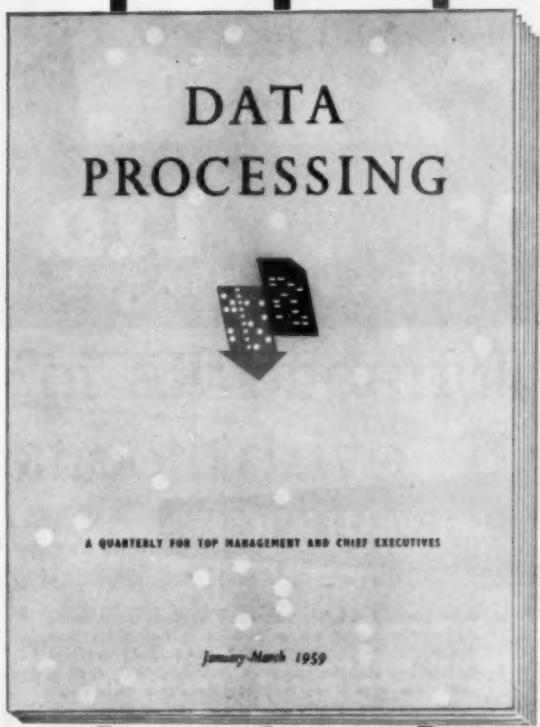
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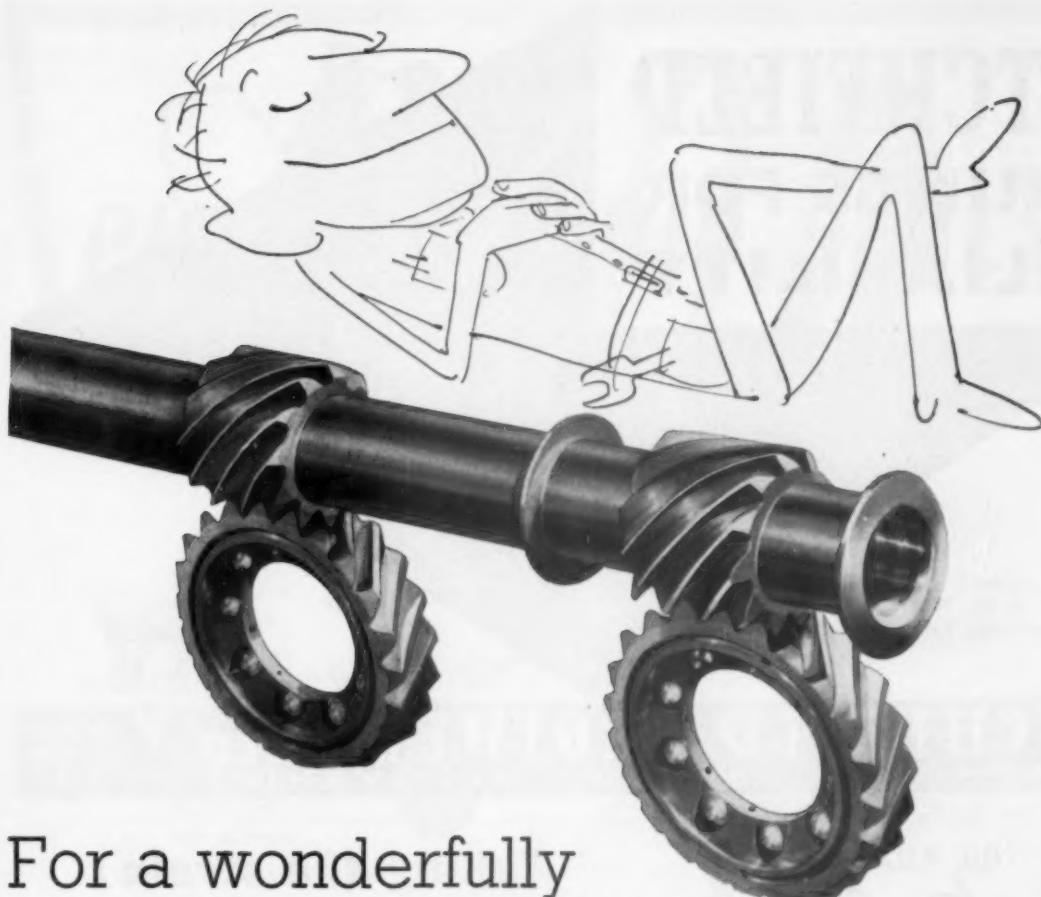
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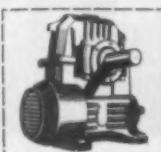
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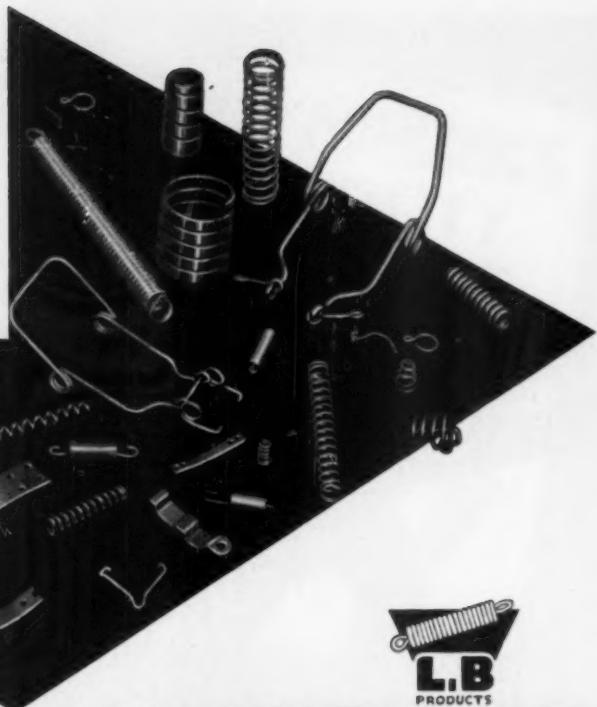


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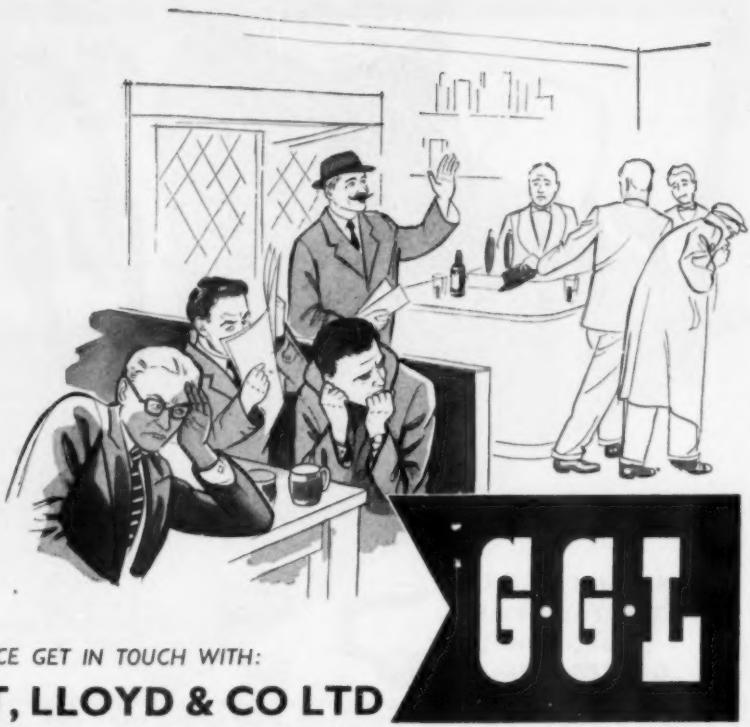
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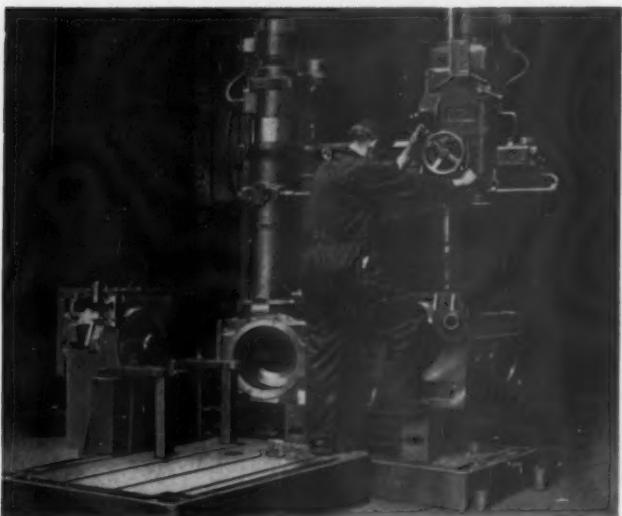


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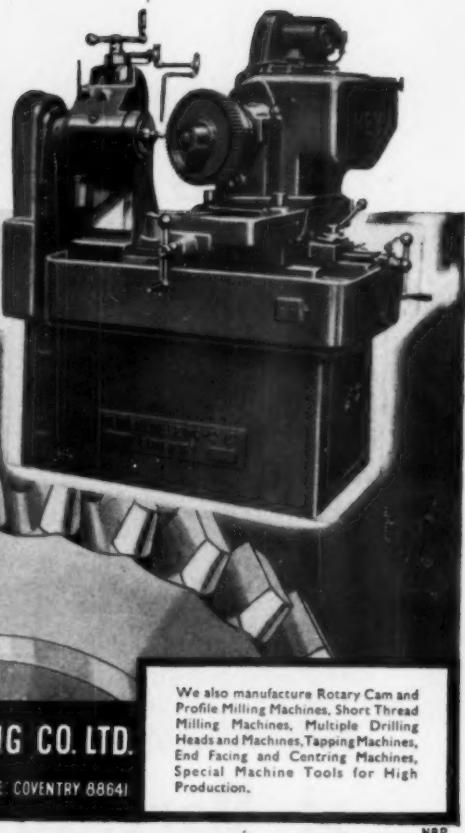
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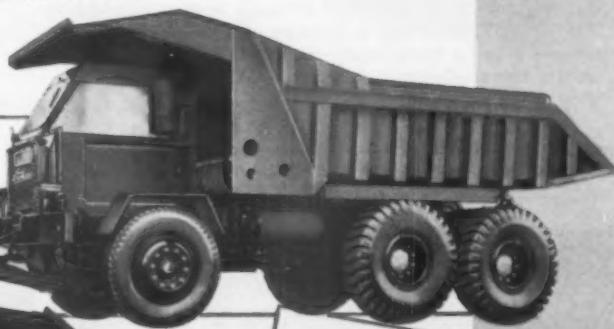
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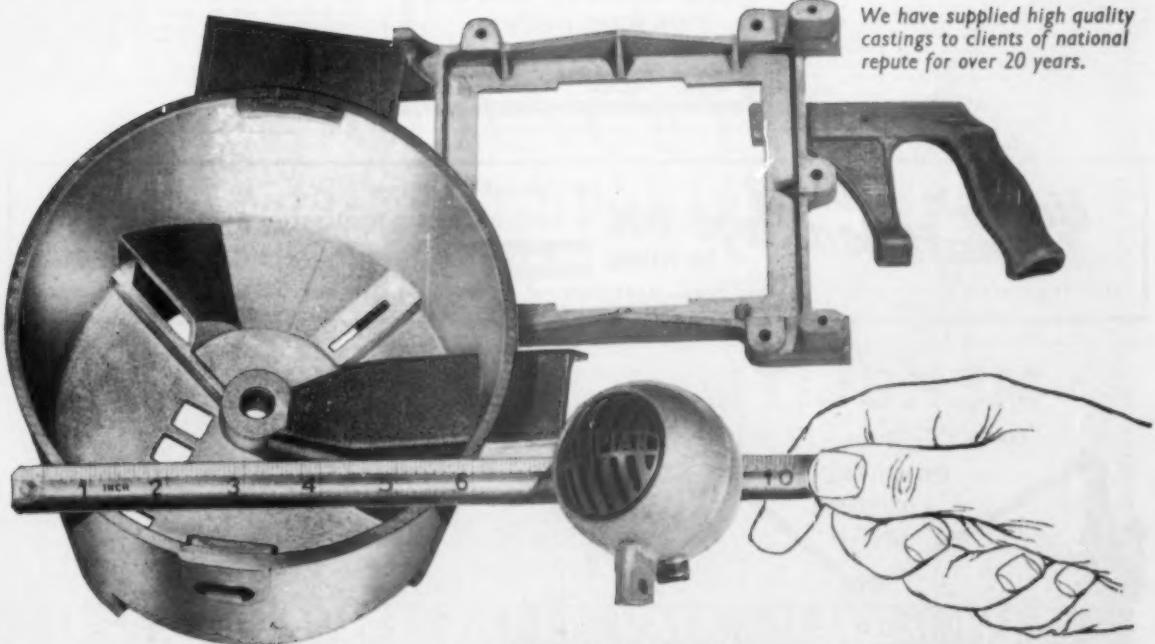


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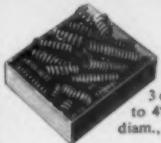
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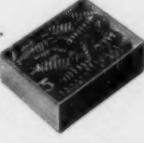


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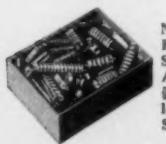


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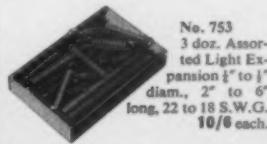
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